

THE PHILIPPINE AGRICULTURIST

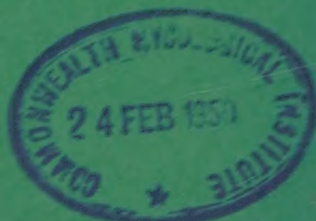
UNIVERSITY OF THE PHILIPPINES PUBLICATIONS SERIES A

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FACTORS IN THE PRODUCTION OF GREEN DUCKS¹

JONÉ B. JULIAN

During the hatching season in commercial duck hatcheries, large numbers of unwanted male ducklings are produced because only one male out of every ten females is reserved for breeding purposes. The excess males are either sold at practically give-away prices² or fed to hogs. These excess males may be utilized to advantage by raising them as "green ducks."³

In the Philippines, duck meat has not yet met with sufficient favor to warrant its production on a commercial scale, owing apparently to the poor quality of the meat of the old and culled ducks, the usual source of duck meat offered in the market. Green ducks offer a very promising source of meat. Hurd and Hilbert (1936) reported that duck meat has more energy value to the pound than chicken meat because it usually carries more than twice as much fat as is found in young chickens. They also reported that duck meat is also equal to pork chop in this respect and compares favorably with chicken meat in vitamin content.

The only study on the possibilities of green duck production in the Philippines was made by Fronda and Cruz in 1931. They reported that a fair profit could be realized from green ducks, and that a gross profit of 77 per cent of the total working capital invested may be realized in feeding the ducklings within a period of eight weeks; but when the ducklings were marketed at ten weeks of age, there was a gross profit of only 49 per cent.

A study to determine the factors in the cost of producing green ducks on a commercial scale was conducted in the Department of Animal Husbandry from November, 1946, to July, 1947.

PLAN OF THE EXPERIMENT

Three trials of one hundred male ducklings each were made. The first trial covered a period of nine weeks and the second and third trials, a period of ten weeks each. The first trial was started on November 25, 1946, the second, on February 12, 1947, and the third, on May 7, 1947.

¹Experiment Station Contribution No. 1517. Thesis presented for graduation, 1948, with the degree of Bachelor of Science in Agriculture from the College of Agriculture. Prepared in the Department of Animal Husbandry under the direction of Professor F. M. Fronda.

²When this study was conducted, female ducklings were sold at ₱200.00 a hundred and males, at only ₱10.00 a hundred.

³Young ducks forced to rapid growth and marketed when nine to thirteen weeks of age.

The ducklings were housed in a pen, the floor of which was covered with a thick layer of rice hulls. Adjoining the pen was a grassy yard where the ducklings were turned loose when they were old enough to graze. This yard, with an area of 144 sq. m., was divided into two lots which were used alternately.

The growing ration for ducklings recommended by Ancheta (1940) was used in this study. This ration consisted of 56.25 parts rice bran, 18.75 parts finely ground corn, and 25 parts shrimp meal (all parts by weight). The first feed given to the ducklings consisted of a mixture of the prescribed ration mixed with a little boiled rice, the amount of which was gradually reduced until it was totally omitted from the ration after the tenth feeding.⁴ The feed was given in a sloppy mash four times a day, at six and at ten o'clock in the morning and at two and at six o'clock in the afternoon. This feeding was reduced to three times a day after the ducklings were one month old. The ducklings were allowed to eat as much feed as they could at each feeding time, and any feed left over after they had had their fill was removed. They were also given as much chopped green grass as they could consume at each feeding. Clean drinking water was available to them at all times.

All the ducklings in the three trials were given the same care and management. The left-overs were removed before they attracted ants and rats. The drinking troughs were so fixed that the ducklings could not wade in them. The floor and the feeding troughs were cleaned after every feeding.

The ducklings were kept in the house until they were about three weeks old. However, they were given morning sunshine every day by opening the door of the house. When they were big enough, they were provided with a small run adjoining the house where they were fed. Later, they were allowed the use of the whole run until the end of the experiment.

At night, from the start of the experiment until the ducklings were about one month old, the birds were placed in boxes provided with adequate ventilation and covered with wire to keep them from rats. The house was closed to avoid exposure to draft.

Records kept

The initial and weekly individual weights of the ducklings, the amount of feed consumed, the labor spent in the actual care and management of the ducklings, the mortality, the returns from the sale of green ducks, and other observations made were recorded.

⁴Boiled rice is the feed used by the duck raisers in Pateros during the first week of brooding.

Items of cost

The items of cost were grouped into feed cost, labor cost, and other costs which included cost of the stock, repairs, tax, depreciation of the building and fences, interest on the use of the land, interest on the stock, interest on the use of the building and fences, and interest on the working capital.

Feed cost. The price of the feed used was 32 centavos a kilogram. The actual amount of feed consumed in every trial was accordingly charged.

Labor cost. A laborer was employed to take charge of the care and feeding of the ducklings, of cleaning the pens and yards, and to do various minor chores attendant to management. This laborer received a daily wage of ₱2.00 for 8 working hours, or 25 centavos an hour. It was observed that an average of 12 hours a week was devoted to the ducklings. On this basis, it was estimated that the cost of labor used in the care and management of the three trials was ₱27.00 for trial I, and ₱30.00 each for trials II and III.

Other costs: Cost of the stock. The price of a duckling being 10 centavos, and with 100 ducklings in every trial, the amount of ₱10.00 was charged in each case.

Repairs. The pen and the fences used in this study were valued at ₱56.56 and ₱40.69, respectively, or a total of ₱97.25. The cost of repairs of the pen and fences was set at 2 per cent a year, or 33 centavos for the nine-week use in trial I and 37 centavos each in the case of trials II and III.

Tax. A tax of $7/8$ of one per cent was charged for the use of the land with a total area of 144 sq. m. At ₱500.00 a hectare, the land was valued at ₱7.20 with a tax of one centavo for trial I and one and a half centavos each for trials II and III.

Depreciation. The pen and fences were estimated to last for 30 years. The cost of depreciation for one year was obtained by dividing their total value of ₱97.25 by 30. Since these were used for only nine weeks in the first trial and ten weeks each in trials II and III, the amounts of depreciation charged were 56 centavos for trial I, and 62 centavos each for trials II and III.

Interest. The ducklings were housed in a pen valued at ₱56.56. For the fence were used 64 yards of chicken wire at 16 centavos a yard and 21 concrete posts at ₱1.45 each. The cost of the fence was ₱40.69, so that both pen and fence cost ₱97.25. At 6 per cent interest a year, the charge against each trial amounted to ₱1.01 in trial I, ₱1.12 in trial II, and ₱1.12 in trial III.

The charge for the use of the land at 6 per cent a year was seven centavos in trial I, eight centavos in trial II, and eight centavos in trial III.

The total working capital was made up of the feed cost, labor cost, cost of the stock, repairs, and tax, which amounted to ₱139.00 in trial I, ₱156.11 in trial II, and ₱162.63 in trial III. At 6 per cent interest a year, ₱1.44 was charged against trial I, ₱1.80 against trial II, and ₱1.88 against trial III.

RESULTS AND DISCUSSION

Weight and rate of growth of the ducklings

The record of the average weekly weights of the ducklings used in this study showed that in all three trials, the ducklings grew very rapidly from the start to the end of the experiment. The average initial weights were 47.7 ± 0.42 grams in trial I, 50.2 ± 0.43 grams in trial II, and 45.8 ± 0.47 grams in trial III. At the end of the second week the average weight had increased to more or less three times the average initial weights in all the trials; this differs from the finding among Muscovy ducks by Catalan (1946), who observed that the drakes doubled their initial weights at the end of the third week.⁵

The average weekly gain in weight of the ducklings in trial I was 87.5 grams, in trial II, 67.0 grams, and in trial III, 69.1 grams. The appreciable difference in the rate of growth of the ducklings in the three trials may be due to the difference in weather conditions at the time they were raised. The ducklings in the first trial were raised from November 25, 1946, to January 27, 1947, a period when the weather was neither too warm nor too cold for comfort; the ducklings in the second trial, during the hottest part of summer; and those in the third, when it was hot and partly rainy. The average weights of the ducks at the end of each trial were 835.1 ± 22.7 grams in trial I, 720.3 ± 21.4 grams in trial II, and 736.8 ± 22.11 grams in trial III. These weights are much lower than the average weight observed by Fronda and Cruz (1931), which was 1,020 grams. The difference was probably due to the weather conditions at the time the ducklings were raised and partly to the kind of feed given. Trial I of this study, which was conducted during practically the same time of the year that Fronda and Cruz (1931) conducted theirs, gave an average weight of only 134 grams lower after a period of nine weeks.

Feed consumption and cost

The usual rates of increase in feed consumption in the three trials as the ducks advanced in age were observed in this study. Naturally, the cost of feed increased in the same proportion. In all cases there was

⁵CATALAN, L. V. 1946. Studies on the rate of growth of Muscovy ducks. (Thesis presented for graduation with the degree of Bachelor of Science in Agriculture. Unpublished.)

no restriction on the amount of feed given the ducklings. The total amount of feed consumed by the ducklings for a period of nine weeks was 254 kgm. in trial I, 266 kgm. in trial II, and 243.5 kgm. in trial III, or an average of 254.5 kgm. for the three trials. Computed on the basis of 100 birds, the consumption in trial I was 317.7 kgm., 309.8 kgm. in trial II, and 316.3 kgm. in trial III, or an average of 314.6 kgm. for a period of nine weeks. The total amount consumed by the ducklings in ten weeks was 309 kgm. in trial II, and 291.5 kgm. in trial III. On the basis of 100 birds, the ducklings in trial II consumed 361.7 kgm. and those in trial III, 382.0 kgm. This shows that an average of 371.8 kgm. of feed was consumed in ten weeks. These figures compare favorably with the amount reported by Fronda and Cruz (1931), who observed that up to the age of nine weeks, 100 ducks consumed 326 kgm., and up to the age of ten weeks the same number of ducks consumed 389.5 kgm. of feed.

Based on the current price of feed when the experiment was conducted, the cost of feed actually consumed by the ducks was ₱81.28 in trial I, ₱98.88 in trial II, and ₱93.28 in trial III. The cost for every 100 birds was ₱101.66 in trial I, ₱115.73 in trial II, and ₱122.25 in trial III, or an average of ₱113.21.

Compared with the cost of raising 100 ducks to the tenth week reported by Fronda and Cruz (1931) which was ₱31.16, the cost of producing weanling ducks in the present investigation was higher, although the average amount of feed consumed at the end of ten weeks in trial II and III was less by 17.7 kgm. This is so because at the time of the present experiment the cost of feed was abnormally high. The amount of feed needed to produce a kilogram of green ducks, therefore, appears to be a better means of comparison. In this study, an average of 4.63 kgm. of feed was needed to produce one kilogram weight of green ducks, whereas Fronda and Cruz (1931) reported only 3.81 kgm. It may be seen even from these figures that in the present study green ducks were raised less economically than those reported by these investigators.

It was observed that the most economical gains were produced during the early stages, from the first to the seventh week. During the first three weeks the ducklings in trial II required more feed to produce a kilogram gain than those in the other two trials perhaps because of the very hot weather then, which seemed to hamper the growth of the ducklings. The atmospheric temperature at the time, as recorded by the local weather observatory, ranged from 28.4°C to 32.6°C, or an average of 30°C. In all the three trials, the gains were economical up to the seventh week. Beyond this period, however, the amount of feed required to produce a kilogram gain was very high and consequently proved to be uneconomical. These figures seem to point out that the most profitable time to market the ducks

is soon after the ducklings are seven weeks old. At that age, however, the ducklings weighed only 0.54 kgm. each, an individual size hardly big enough for the table. Besides, the ducklings at this age were still growing their feathers, making it difficult to dress them. Even at the age of ten weeks, green ducks bought by housewives were found difficult to dress because of the presence of very many pin feathers.

Mortality

In this study the death rate was rather high in the first and last trials. The percentages of mortality were 22 per cent in trial I, 17 per cent in trial II, and 27 per cent in trial III. In the first trial 12 ducklings, or 12 per cent, died during the first week, 3 per cent the second week, and 1 per cent each the third and fourth weeks. The last death was recorded in the seventh week. In the second trial, the greater percentage of mortality occurred in the first five weeks. The last two deaths in the eighth and tenth weeks were probably due to the extreme heat that characterized the period. The ducklings panted and eventually died. In the third trial the ducklings were reared during rainy weather, and the too-wet condition of the ground probably had a bad effect on the ducklings.

In all the three trials the highest mortality occurred during the first five weeks, tending to show that the most critical stage in the life of the ducklings is the first five weeks after hatching. The average mortality of the three trials was 22 per cent. This was more than double that of the 10 per cent mortality reported by Fronda and Cruz (1931).

Cost factors in green duck production

Table 1 gives a summary of costs and returns from green duck production computed on the basis of 100 individuals. In determining the average net cost of production on the basis of 100 ducklings, the cost of feed, labor, stock, repairs, tax, depreciation of building and equipment, and interests on building and equipment, land and the working capital, which amounted to ₱156.05, were deducted from the average receipts from all the trials. The total cost of production amounted to ₱142.08 in trial I, ₱159.73 in trial II, and ₱166.33 in trial III. The cost of feed alone was ₱101.66 in trial I, ₱115.73 in trial II, and ₱122.25 in trial III, or an average of ₱113.21 in the three trials. Feed expenses represented 72.5 per cent of the total expenditures. Labor was the next biggest item of expense: ₱27.00 in trial I and ₱30.00 each in trials II and III, or an average of ₱29.00 for the three trials, which was 18.61 per cent of the total cost of production.

A net loss in all the trials resulted after the cost items were deducted from the total receipts derived from the sale of the ducklings. The largest net loss was obtained in trial III, which amounted to ₱55.81, or 33.49 per cent of the total cost of production; next was in trial II, which reached

₱51.68, or 32.26 per cent of the total cost of production. The smallest loss, that in trial I, was ₱16.81, or 11.83 per cent of the total cost of production. The average loss of the three trials was ₱41.44, or 25.9 per cent of the total cost of production. These results are contrary to the report made by Fronda and Cruz (1931), who concluded that green ducks may be raised for profit. The difference in these results may be accounted for by the fact that the cost of feed, labor and stock during this experiment was abnormally high, whereas the selling price of duck meat was very low. Also, several items of expense considered in this study were not taken into consideration in the earlier one. In addition, the high percentage of mortality, 22 per cent in all three trials, undoubtedly contributed materially to the losses incurred in this investigation.

In the study of Fronda and Cruz (1931), the cost of feed was eight centavos a kilogram, and the green ducks were sold at 50 centavos a kilogram. The ratio of the cost of feed to the selling price of the green ducks was 1:6.25. In the present study, however, the cost of the feed used was 32 centavos a kilogram, and the green ducks were sold at only ₱1.50 a kilogram, so that the ratio of the cost of the feed to the selling price of ducks was only 1:4.69. If the ratio of 1:6.25 were followed, the green ducks should have been sold at ₱2.00 a kilogram instead of only ₱1.50. Under the conditions of the experiment, the ducklings should have been sold at ₱2.05 a kilogram to avoid losses.

Feed constituted the biggest item of expense in the production of green ducks, labor next, and cost of the stock third. Feed alone accounted for 72.5 per cent of the total expenses. Labor charges amounted to 18.61 per cent, and the cost of stock 6.44 per cent. All the other items of expense, which included repairs, tax, depreciation, and interests, were practically the same and represented only a small proportion of the expenses. The interest on building and equipment, the depreciation, and the interest on the working capital amounted to only 2.16 per cent.

SUMMARY AND CONCLUSIONS

1. The most rapid growth of the ducklings was from the first to the seventh week. After this period the increase in weight was no longer economical.

2. The amount of feed needed to raise 100 ducklings to nine weeks of age was 314.6 kgm. and to ten weeks, 371.8 kgm. At this rate, it needed 4.63 kgm. of feed to produce a kilogram of green duck.

3. The total cost of producing 100 green ducks in the present study was ₱156.05, of which feed represented 72.5 per cent, labor 18.61 per cent, and stock 6.44 per cent. The remaining 2.45 per cent is distributed among the minor items of expense.

4. The net loss incurred in the raising of green ducks under the conditions that prevailed during the study was ₱41.44, or 25.9 per cent of the total cost of production.

5. The results of this study show that there is no profit in raising ducks for meat when the cost of feed is high. On the basis of the cost of feed at the time of the experiment, the selling price of green ducks should have been ₱2.05 a kilogram, instead of only ₱1.50 a kilogram to avoid losses.

6. The mortality observed in this study occurred largely during the first five weeks. The average mortality was 22 per cent.

7. The ideal time for raising green ducks seems to be during the latter part of the rainy season and the early part of the dry season, when the weather is fairly cool and when there are no heavy rains and storms.

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- FRONDA, F. M., AND G. B. CRUZ. 1931. Preliminary studies on the possibilities of green duck production. *Philippine Agriculturist* **19**: 591-600. *Fig. 1; chart 1.*
- HURD, L. M., AND K. F. HILBERT. 1936. Duck growing. *Cornell Extension Bulletin* 345: 1-52.

TABLE I
Costs of production of green ducks, computed on the basis of 100 ducklings

I T E M S	TRIAL I		TRIAL II		TRIAL III		A V E R A G E	
	Cost Pesos	Percentage	Cost Pesos	Percentage	Cost Pesos	Percentage	Cost Pesos	Percentage
Feed cost.....	101.66	71.55	115.73	72.45	122.25	73.50	113.21	72.50
Labor cost.....	27.00	19.00	30.00	18.78	30.00	18.04	29.00	18.61
Other costs:								
1. Cost of stock.....	10.00	7.04	10.00	6.26	10.00	6.01	10.00	6.44
2. Repairs.....	0.33	.23	0.37	.23	0.37	.22	0.36	.23
3. Tax.....	0.01	.01	0.01	.01	0.01	.01	0.01	.01
4. Depreciation of bldg. and equip.....	0.56	.40	0.62	.39	0.62	.37	0.60	.38
5. Interest on:								
a. Building and equipment.....	1.01	.71	1.12	.70	1.12	.67	1.08	.69
b. Land.....	0.07	.05	0.08	.05	0.08	.05	0.08	.05
c. Working capital.....	1.44	1.01	1.80	1.13	1.88	1.13	1.71	1.09
Total cost of production.....	142.08	100.00	159.73	100.00	166.33	100.00	156.05	100.00
Receipts from sales of green ducks.....	125.27		108.05		110.52		114.61	
Net returns.....	-16.81		-51.68		-55.81		-41.44	

THE CULTURE OF GUATEMALA GRASS, GUINEA GRASS, MERKER, AND NAPIER FOR SOILAGE¹

VALERIANO C. CALMA AND FEDERICO V. RAMOS
Of the Department of Agronomy

Guatemala grass (*Tripsacum laxum* Nash.) was introduced into the Philippines on April 11, 1919 from the United States Department of Agriculture (Anon. 1925). It is reported as yielding 36,500 kilograms of soilage a hectare a year. According to Galang and Cruz (1929), this grass was relished by horses and carabaos, especially the latter. Paggao² observed that Guatemala was the most palatable to horses and the heaviest yielder (85,928.76 kgm. a hectare a year) among the three grasses he studied.

Napier (*Pennisetum purpureum* Schum.) has been studied in this College and elsewhere. Galang and Paulino (1925) reported that when 20, 30, and 40 days old, it was palatable to cattle, carabaos, and horses, but it became less palatable as it matured to 90 days of age. Napier was less palatable than buñgalon (*Panicum stagninum* Retz.), Cayene (an unidentified species of grass), Uba cane, Guatemala, Guinea grass (*Panicum maximum* Jacq.), Dallis (*Paspalum dilatatum* Poiret), and Para grass (*Panicum barbinode* Trin.). Napier was more palatable to horses than cogon or culape (*Paspalum conjugatum* Berg.) but less palatable than Guinea grass (Pepa, 1927). Suratus (1933) found that Napier was very palatable to young and mature goats. Tuya³ observed that Napier was more palatable to horses than culape or peanut hay, less palatable than Guinea grass or barit (*Leersia hexandra* Siv.) and as palatable as sugar cane tops cut 1.3 cm. long. Villegas (1936) reported that the average annual production a hectare of Napier soilage was 29,331.1 kgm. in one culture and 28,440 kgm. in another culture.

Guinea grass was introduced into the Philippines in 1907 (Anon., 1947). According to Villegas (1935), this forage gave an average yield of

¹Experiment Station Contribution No. 1518. Read before the Los Baños Biological Club, College of Agriculture, on November 26, 1948.

²PAGGAO, AMADO B. A comparative study of Guatemala (*Tripsacum laxum* Nash.), Dallis (*Paspalum dilatatum* Poiret), and Cahumayhumay (*Andropogon intermedius* R. Br. var. Haenkei (Presl) Hack) grasses as to yield and palatability to horses. (Thesis presented for graduation with the Degree of Bachelor of Science in Agriculture from the College of Agriculture, 1933. Unpublished.)

³TUYA, MANUEL A. A comparative study of the palatability of some common Philippine forages for horses. (Thesis presented for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture, 1930. Unpublished.)

17,438 kgm. a hectare in one year when planted 75 cm. by 90 cm., and an average yearly production of 25,494 kgm. when planted one meter each way.

The propagation of these four grasses for soilage was studied from October, 1947, to November, 1948, in co-operation with the Department of Animal Husbandry.

MATERIALS AND METHODS

A level field of clay loam, with an area of 2,240 sq. m., was prepared as in ordinary upland method of land preparation. It was plowed twice with a tractor and disc-harrowed after each plowing. After the field was plowed and harrowed with animal-drawn implements, furrows 80 cm. apart were made with an ordinary moldboard plow.

The field was divided into four plots of 560 sq. m. each. Each grass was planted in a plot of 10 furrows.

The planting materials of the four grasses were taken from the stock cultures of the Department of Agronomy. For Merker and Napier the base, middle, terminal, cutback, "lalas", and suckers were used for seeding the plots. The same parts were used for Guatemala, except the "lalas". For the Guinea grass, only suckers and cuttings of the base were used.

The base, middle, and top seed pieces were taken from the nonflowering stalks; each was divided into three portions, and each portion, 30 to 35 cm. long with three or more eyes, was used as a seed piece.

When the "lalas" of Merker or Napier was used, the upper portion of the stalk which had flowered and contained sprouted buds or shoots was taken and cut diagonally in the middle of the internodes so that each "lala" had one node. The leaves were trimmed off to one-third.

In Guatemala, Merker, and Napier, the young suckers were separated from each other and each was used as planting material. In Guinea grass, the entire stool or rootstock was divided into seed pieces of three to five shoots or suckers each. The leaves of the suckers were also trimmed off to one-third.

The different grasses were planted from November 18 to 20, 1947, one seed piece in a hill, except in the case of Guinea grass of which three to five basal cuttings were used. The hills were set 50 cm. from each other in furrows 80 cm. apart.

The percentage of emergence of the shoots from the seed pieces was recorded on December 18, 1947, and the missing hills were replaced on the same date.

Alternate hilling up and off-barring and occasional weeding were done whenever necessary.

When the grasses were believed suitable for feeding or when they were palatable to the animals, they were cut at the base about five centimeters above the ground. The forage was removed from the field and weighed on a livestock balance. No harvesting was done when it was raining or when the plants were very wet.

RESULTS AND DISCUSSION

The shoots of the different seed pieces emerged practically at the same time, about two weeks from planting (table 1). In Merker and Napier, all of the different seed pieces had fairly high percentage of shoot emergence: in Merker, 95 to 100 and in Napier, 91.33 to 99.30. For these two grasses, any form of the planting materials tried may be used in commercial culture. With Guatemala, the terminal cuttings and the suckers had decidedly poorer shoot emergence than the cut-back, basal, or middle cuttings. This might have been due to their succulence which predisposed them to decay. The suckers of Guatemala produced the lowest shoot emergence, 76 per cent, as compared with the 98.53 per cent of the middle cuttings. Undoubtedly, the suckers suffered when they were separated from the mother rootstock or stool. This is a point of interest from the standpoint of economy of labor, as the preparation of suckers for planting materials is more laborious than preparing the other kinds of seed pieces. Guinea grass can only be commercially propagated by suckers; none of the basal cuttings sent out shoots.

The different grasses were shorter during the dry season than during the wet months.

In the first cutting, the four grasses had only few tillers; the tillers increased in the succeeding cuttings.

Guatemala was cut when it attained a height of 150 to 200 cm.; Merker, 150 to 180 cm. at the boenting or blooming stage; Napier, 150 to 200 cm., boenting or blooming; and Guinea grass, 150 to 180 cm. at bloom or full bloom (table 2).

Napier and Merker were the earliest to harvest; it took only 37 and 39 days, respectively, from planting. It took Guinea grass 82 days and Guatemala 157 days from planting to the first harvest.

Napier gave nine crops of soilage, the greatest number of cuttings in one year; Merker and Guinea grass, six cuttings each; and Guatemala, only three. Napier was cut on the average every 40.22 days; Merker, 52.7; Guinea grass, 48; and Guatemala, 108.

Napier had the highest yield of soilage in one year with a total computed yield of 129,618.51 kgm. a hectare, or an average of 14,402.06 kgm. a hectare at each cutting. Merker ranked second in yield with a total of 111,128.91 kgm. a hectare a year, or an average of 18,521.49 kgm. a

hectare at each cutting. Guatemala was third in yield of soilage with a total of 91,392 kgm. a hectare a year, or an average of 30,464 kgm. a hectare at each cutting. Guinea grass had the lowest yield of soilage with a total of 62,123.63 kgm. a hectare a year, or an average of 10,353.94 kgm. a hectare per cutting.

This yield of 129,618.51 kgm. a hectare a year for Napier was much greater than that obtained by Villegas (1936) who reported that in 1931 the planting made on October, 1930 yielded 59,656.41 kgm. a hectare. Likewise, the yield of 62,123.63 kgm. of Guinea grass soilage was much greater than the 26,216.9 kgm. a hectare in the first year reported by Villegas (1935). Also, the 91,392 kgm. of soilage a hectare a year obtained from Guatemala was more than that reported by Paggao⁴. These differences in yield might have been due partly to the more favorable weather conditions and better soil in this study.

On the whole, it may be noted in table 2 that the first crop of soilage of the four grasses was not so good as the succeeding harvests. This was probably due to the increase of tillers as the crop grew older. It was also observed that, in general, a higher yield of soilage was obtained during the wet season than during the dry months.

SUMMARY

1. Six different kinds of seed pieces of four forage grasses were tried for commercial propagation. For Merker and Napier, base, middle, top, cut-back, "lalas", and suckers were used; for Guatemala, base, middle, top, cut-back, and suckers; and for Guinea grass, suckers and basal cuttings.

2. All of the six different kinds of seed pieces used in Merker and Napier produced fairly high shoot emergence; in Merker, the emergence of the shoots was 95 to 100 per cent, and in Napier, 91.33 to 99.30. These two grasses can be planted commercially by any of the seed pieces tried. The cut-back, base, and middle cuttings of Guatemala gave decidedly higher percentage of shoot emergence than either the tops or suckers. Guinea grass was propagated commercially by suckers; none of the basal cuttings grew.

3. Guatemala was harvested when it was 150 to 200 cm. high; Guinea, 150 to 180; Merker, 150 to 180; and Napier, 150 to 200. When harvested, Guinea, Merker, and Napier were either at boenting or blooming stage. The four forage grasses were shorter during the dry season and taller during the wet months.

4. Napier and Merker were the earliest to be cut and Guatemala, the latest. Napier gave nine cuttings of soilage in one year; Merker and

⁴*Ibid.*

Guinea grass, six each; and Guatemala, three. On the average, Napier was cut every 40.22 days; Merker, 52.7; Guinea grass, 48; and Guatemala, 108.

5. Napier gave the most soilage in one year, 129,618.57 kgm. a hectare and Merker, second, 111,128.91 kgm. a hectare a year, or 18,521.49 kgm. a hectare at each cutting. Guatemala was third with 91,392 kgm. a hectare a year, or 30,464 kgm. a hectare at each cutting. Guinea grass produced the least soilage with only 62,123.63 kgm. a hectare a year, or 10,353.94 kgm. a hectare at each cutting.

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TABLE 1

Percentage of emergence of the shoots of the different seed pieces of the four forage grasses

NAME OF FORAGE	KIND OF SEED PIECES	CUTTINGS		EMERGENCE <i>per cent</i>
		Planted <i>No.</i>	Emerged <i>No.</i>	
Napier (<i>Pennisetum purpureum</i> Schum.)	Base	144	143	99.30
	Middle	135	132	97.77
	Terminal	150	137	91.33
	Cut-back	78	75	96.15
	"Lalas"	104	96	92.30
	Suckers	172	168	97.67
Merker (<i>Pennisetum purpureum</i> Schum.)	Base	100	98	98.00
	Middle	98	98	100.00
	Terminal	100	96	96.00
	Cut-back	100	95	95.00
	"Lalas"	50	50	100.00
	Suckers	172	167	97.09
Guinea Grass (<i>Panicum maximum</i>)	Suckers	1,587	1,158	72.97
	Basal cuttings	100	0	0.00
Guatemala (<i>Tripsacum laxum</i> Nash)	Base	185	180	97.35
	Middle	162	158	98.53
	Terminal	144	116	80.55
	Cut-back	80	74	92.50
	Suckers	133	101	76.69

TABLE 2
Date of cutting, age of the plants when cut, and yield of soilage of the forage grasses at different cuttings

CUTTING No.	NAPIER				MERKER				GUINEA				GUATEMALA			
	Cutting		Yield		Cutting		Yield		Cutting		Yield		Cutting		Yield	
	Date	Age days	Actual kgm.	of a ha. kgm.	Date	Age days	Actual kgm.	of a ha. kgm.	Date	Age days	Actual kgm.	of a ha. kgm.	Date	Age days	Actual kgm.	of a ha. kgm.
1	25 12 47	37	75.38	1,335.53	27 12 47	39	82.08	1,465.12	10 4 48	82	156.68	2,796.73	24 4 48	15	869.00	15,511.65
2	3 2 48	40	341.95	6,100.80	12 2 48	47	541.43	9,664.52	17 3 48	35	229.02	4,088.00	12 7 48	79	2,340.00	41,769.00
3	16 3 48	41	746.49	13,224.84	24 4 48	70	558.20	9,963.87	23 4 48	37	310.00	5,533.50	11 10 48	88	1,911.00	34,111.35
4	23 4 48	39	560.00	9,996.00	22 6 48	60	1,305.00	23,294.25	21 6 48	59	713.00	12,727.05				
5	23 6 48	60	1,410.00	25,168.50	25 7 48	33	1,569.00	28,006.65	4 8 48	44	1,314.00	23,454.90				
6	24 7 48	31	1,355.00	24,186.75	30 9 48	67	2,170.00	38,734.50	4 9 48	31	757.00	13,523.45				
7	12 9 48	50	1,047.00	18,689.95												
8	5 10 48	23	415.00	7,407.75												
9	15 11 48	41	1,317.00	23,508.45												
Total		362	7,267.82	129,618.57		316	6,225.71	111,128.91		288	3,479.70	62,123.63		324	5,120.00	91,392.00
Av.		40.22		14,402.06		52.7		18,521.49		48		10,353.94		108		30,464.00

TREATMENT OF STRUCTURAL BAMBOO WITH DDT AS A PRESERVATIVE AGAINST POWDER-POST BEETLES¹

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WITH ONE TEXT FIGURE

Bamboo is a structural material used in Philippine rural communities. Its use for construction purposes, however, is often hampered by infestations with the powder-post beetle, *Dinoderus minutus* Fabr., which bores into and feeds on the inside portions and weakens the bamboo. In the Philippines there is a common belief, undoubtedly based on fairly accurate observations, that bamboo stems intended for building purposes should be cut in December in order to escape injury from powder-post beetles. Uichanco (1927)² explained that bamboos cut during this so-called cutting month are mature and are less susceptible to beetle attack than the immature ones. Even this method, however, does not insure freedom from beetle infestations. According to Uichanco (1934)³:

"Of the bamboo stems cut in any month of the year, including the supposed cutting season, certain pieces, even though presumably mature, were found to be susceptible to infestation. However, one important point brought out in our work was that susceptible pieces began to show beetle invasion within one month after cutting. The experiments have since been continued and our material seems to indicate that stems which showed immunity during that first month have continued to be pest free; hence a practical method of selecting bamboo for more permanent construction. Unfortunately, the same criterion cannot be applied to the cheaper *tewanak*, *Bambusa vulgaris* Schrad., which seems to be unusually attractive to powder-post beetles."

There is, therefore, a need for a more dependable way in which bamboos to be used for construction purposes may be cut at any time and remain free from powder-post beetle damage.

The object of the present experiments was to determine the efficacy of DDT for preventing the powder-post beetle, *Dinoderus minutus*, from infesting structural bamboos.

MATERIALS AND PROCEDURE

"Tewanak," *Bambusa vulgaris* Schrad., was used in the experiments because it is very susceptible to *Dinoderus* damage. If DDT treatment

¹Experiment Station Contribution No. 1519.

²UICHANCO, L. B. 1927. Insects in Philippine folklore. Philippine Agriculturist 26: 485-499.

³UICHANCO, L. B. 1934. A twenty-five year balance sheet for economic entomology. Philippine Agriculturist 23: 419-429.

could satisfactorily control beetle infestation of this bamboo, it should be more effective on the "maitinik," *Bambusa spinosa* Roxb., a species less susceptible to the pest.

DDT was used in two forms: (1) as a saturated solution in kerosene, and (2) as a 20 per cent neocid⁴ solution in water. For control, tap water was used.

Six stems of tewanak⁵ were cut on September 4, 1947, and numbered with Roman numerals. Each stem was cut into seven pieces of two internodes each, and the sections were labeled from the base upwards with small letters of the alphabet.

Sections a, b, and c of each stem and sections d, e, and f of stems I, II, and III were distributed into six lots according to the method of treatment and the time of application of the insecticide. In lots 1, 2, and 3 the pieces were used whole, and in lots 4, 5, and 6 the sections were split into six in order to expose the inner delicate tissues. In each lot of nine whole pieces, or 54 split pieces, one third, A, was treated with tap water for check; one third was sprayed with kerosene-carried DDT, and one third with 20 per cent neocid as follows:

- Lot 1. Sprayed once, immediately after cutting
 - A Control—with tap water: Sections Ia, IIb, IIIc.
 - B With kerosene-carried DDT: Sections Ib, IIc, IIIa.
 - C With 20 per cent neocid: Sections Ic, IIa, IIb.
- Lot 2. Sprayed once, one week after cutting
 - A Control—with tap water: Sections IVa, Vb, VIc.
 - B With kerosene-carried DDT: Sections IVb, Vc, VIa.
 - C With 20 per cent neocid: Sections IVc, Va, Vb.
- Lot 3. Sprayed twice, one immediately after cutting, and another a month later
 - A Control—with tap water: Sections Id, IIe, IIIf.
 - B With kerosene-carried DDT: Sections Ie, IIg, IIId.
 - C With 20 per cent neocid: Sections If, IIe, IIIe.
- Lot 4. Sprayed once, immediately after cutting
 - A Control—with tap water: Splits Ig, IIg, IIIg.
 - B With kerosene-carried DDT: Splits Ig, IIg, IIIg.
 - C With 20 per cent neocid: Splits Ig, IIg, IIIg.
- Lot 5. Sprayed once, one week after cutting
 - A Control—with tap water: Splits IVg, Vg, VIg.
 - B With kerosene-carried DDT: Splits IVg, Vg, VIg.
 - C With 20 per cent neocid: Splits IVg, Vg, VIg.

⁴Neocid is a factory preparation of Geigy Co., Inc., New York City, containing 50 per cent pure DDT.

⁵The author is indebted to Mr. José P. Esguerra, then Farm Superintendent of the College, for help in securing the bamboo stems.

Lot 6. Sprayed twice, one immediately after cutting, and another a month later

A Control—with tap water: Splits *Ig*, *IIg*, *IIIg*.

B With kerosene-carried DDT: Splits *Ig*, *IIg*, *IIIg*.

C With 20 per cent neocid: Splits *Ig*, *IIg*, *IIIg*

Sections *d*, *e*, and *f* from sections *IV*, *V*, and *VI*, and three splits from sections *IVg*, *Vg*, and *VIg* were discarded because they were not necessary.

The sprays were applied with Universal hand sprayers. One sprayer was used exclusively for the control, one for the kerosene-carried DDT, and another for the neocid solution.

After treatment, the experimental bamboo pieces were put on a sheltered platform outside the Entomology Laboratory. The different sets were separated from each other. Each bamboo piece was examined weekly for beetle infestations for a period of 23 weeks, from September 11, 1947, to February 19, 1948. In order not to repeat counting in subsequent inspections, infestation holes were encircled with pencil marks on the date they were first noted.

DISCUSSION OF RESULTS

Infestations on DDT-treated and untreated unsplit bamboo sections. The relative infestations by powder-post beetles in the control and DDT-treated unsplit bamboo sections are presented in table 1.

When the control and the DDT-sprayed sections in lot 1, where the pieces were sprayed but once immediately after cutting, were compared, the pieces in the control, A, had 41 to 201 infestation holes, or an average of 123.2 holes, on each bamboo section (fig. 1). The pieces sprayed with neocid, C, were free from beetle attack during the entire 23 weeks that the pieces were under observation. The pieces treated with kerosene-carried DDT, B, with an average of 3.3 infestation holes on each bamboo piece, would have been likewise free from beetle infestation had not two of the pieces cracked and afforded infestation points after they had been sprayed. The height of beetle infestation of the unsprayed pieces occurred 11 to 12 weeks after cutting.

In lot 2, where the pieces were likewise sprayed once, but one week after cutting, the control, A, had 27 to 62 infestation holes, or an average of 50.3 holes to a piece.

The initial infestation among the control pieces, as well as among those sprayed with either kerosene-carried DDT or neocid, took place during the first week. However, the infestation was arrested in sets B and C after they had been sprayed with kerosene-carried DDT and neocid, respectively. One of the pieces treated with kerosene-carried DDT cracked and afforded entry for the beetles. The crack increased the number of infestation holes

to an average of 6.3 holes, whereas the pieces sprayed with neocid had 1.0 infestation hole to a piece.

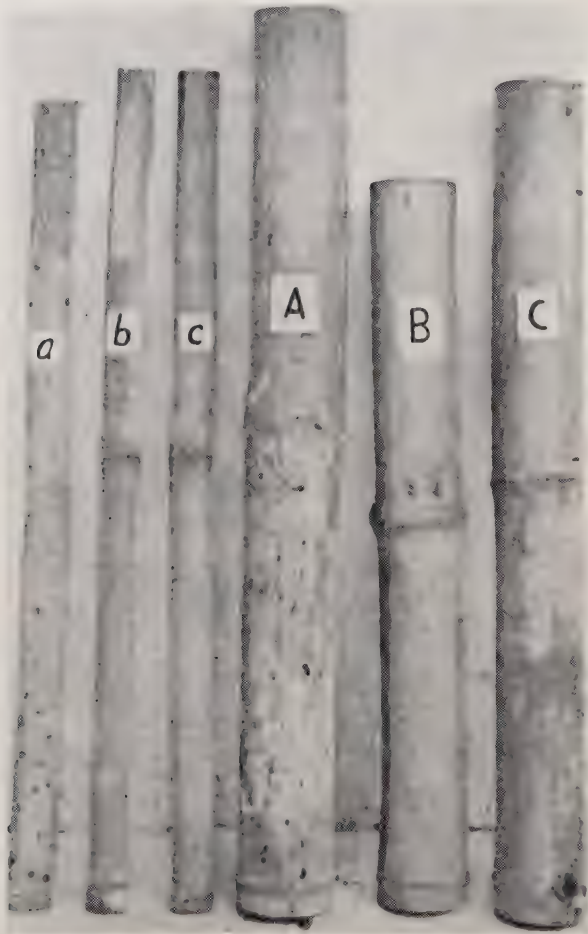


Fig. 1—Tewanak bamboo pieces showing relative infestations with *Dinoderus minutus* Fabricius. *A* and *a* were control, *B* and *b* sprayed with kerosene-carried DDT immediately after cutting, and *C* and *c* with 20 per cent neocid in water. *A* and *a* were badly infested, while *B*, *b*, *C* and *c* were not. The top portions of *a*, *b* and *c* were cut open to show the inside; note that *a* was badly damaged, while *b* and *c* remained sound.

Although the results showed that DDT-treatment arrested the infestation of pieces sprayed one week after cutting, some beetles might have been able to burrow sufficiently deep into the bamboo so that when the pieces were sprayed they could not be reached with the spray, and caused further infestation from within.

In lot 3, in which the pieces were sprayed immediately after cutting and then a month later, the control pieces, A, had 30 to 144 infestation holes, or an average of 76.0 holes, to a bamboo piece. The DDT-treated pieces, B, were relatively free from infestation; the average was 2.0 infestation holes to a piece, whereas those sprayed with 20 per cent neocid, C, had an average of 10.1 infestation holes to a piece. A bamboo section in B and one in C were infested through cracks that appeared after the second spraying.

A comparison made of lot 1, in which the bamboo sections were sprayed once immediately after cutting, and lot 2, where the pieces were likewise sprayed once but a week after cutting, showed that the DDT-treated pieces in lot 1 were not infested by powder-post beetles unless they cracked after they had been sprayed. In lot 2 the pieces were infested during the week before they were sprayed. The infestation in lot 2, however, was checked by the application either of kerosene-carried DDT or 20 per cent neocid. At the end of the experiment the extent of infestation in the two lots was practically the same.

In lot 1 and lot 3, where the bamboo sections were sprayed immediately after cutting, and then a month later, the pieces treated either with kerosene-carried DDT or 20 per cent neocid were free from beetle infestation unless they cracked after they had been sprayed. At the end of the experiment the extent of powder-post beetle infestation in the two lots was practically the same.

In all cases, the DDT-treated pieces of bamboo cracked 9 to 19 weeks after the poles had been cut. Uichanco (1934)⁶ reported that pieces of the maitinik variety of structural bamboo (*Bambusa spinosa* Roxb.) which were not attacked by the beetles one month after cutting remained free from infestation. Apparently, tewanak remains susceptible to beetle infestation much longer than one month, possibly indefinitely, so that retreatment with DDT immediately after the bamboo cracks is necessary for keeping the pieces free from *Dinoderus minutus*.

Infestations of DDT-treated and untreated bamboo splits. The relative infestations by powder-post beetles in the control and DDT-treated bamboo splits are presented in table 2.

In lot 4, where the split pieces were sprayed only once and immediately after cutting, the splits used as control, A, had 108 to 284 infestation holes, or an average of 169.6 holes to a bamboo split; whereas those sprayed either with kerosene-carried DDT, B, or 20 per cent neocid, C, remained free from infestation after 23 weeks of observation. When the control splits,

⁶*Loc. cit.*

A, were opened, they were riddled with beetle tunnels and filled with powdered bamboo substance; the splits with the kerosene-carried DDT remained sound.

In lot 5, where the splits were likewise sprayed once but a week after cutting, the contrast in the degree of infestation in the control, A, and the kerosene-carried DDT, B, though striking enough, was not so conspicuous as in lot 4, where the pieces were sprayed once immediately after the splits were prepared. Although the splits in the control set, A, of lot 5 had an average of 57.3 infestation holes to a bamboo split, the pieces sprayed with kerosene-carried DDT, B, were also infested on an average of 11.0 infestation holes to a piece towards the end of the observation period, 12 to 21 weeks after they had been prepared. The splits sprayed with 20 per cent neocid, C, were almost free from beetle infestation; the average was 0.7 hole to a split, occurring late in the observation period.

In lot 6, where the splits were sprayed first immediately after cutting, and then a month later, the results were identical with those in lot 4. The pieces in the control set, A, were severely infested with an average of 151.3 infestation holes to a split; whereas those sprayed either with kerosene-carried DDT, B, or 20 per cent neocid, C, remained free from infestation. When the control pieces were opened, the inner parts were riddled with beetle tunnels and filled with powder; those treated with kerosene-carried DDT and neocid remained sound.

SUMMARY

1. The efficacy of DDT sprays, either as kerosene-carried DDT or as 20 per cent neocid solution in water, for preventing infestations with the powder-post beetle, *Dinoderus minutus* Fabr., of tewanak, *Bambusa vulgaris* Schrad., a species of structural bamboo that is highly susceptible to the pest, was tested.

2. DDT was effective in preventing powder-post beetle infestations on split or unsplit tewanak bamboo stems. The control pieces were heavily infested, but those sprayed either with kerosene-carried DDT or 20 per cent neocid in water were relatively free from infestation.

3. The cracks that occurred on the unsplit bamboo pieces after these had been sprayed either with kerosene-carried DDT or 20 per cent neocid solution afforded points of entry for the pest.

4. If no cracks occurred on the bamboo stems after they had been sprayed, one application immediately after cutting the pieces proved sufficient for preventing beetle infestations.

5. One week of delay in the application of DDT afforded the beetles a chance to infest the pieces. Spraying the pieces with kerosene-carried DDT or 20 per cent neocid solution in water may arrest the infestations.

TABLE 1
Infestations by Dinoderus minutus Fabricius on DDT-treated and untreated unsplit bamboo sections

	LOT 1. SPRAYED ONCE (IMMEDIATELY AFTER CUTTING)			LOT 2. SPRAYED ONCE (ONE WEEK AFTER CUTTING)			LOT 3. SPRAYED TWICE (IMMEDIATELY AFTER CUTTING AND A MONTH LATER)		
	A Control	B DDT in kerosene	C Neocid	A Control	B DDT in kerosene	C Neocid	A Control	B DDT in kerosene	C Neocid
Age when first infested (weeks)	1-4	^a 9-x	x		b 6-x	1-x	1-2	b 19-x	b 12-x
Age when infestation was heaviest (weeks)	11-12	x	x	12-x	x	x	9-11	x	b 23-x
Age when latest infestation was observed (weeks)	19-23	b 23-x	x	23	b 23-x	9-x	23	b 23-x	b 23-x
Average number of infestation holes per section	123.2	3.3	0	50.3	6.3	1.0	76.0	2.0	10.1

^a x indicates pieces were never attacked.

^b Found in cracks.

TABLE 2
Infestations by Dinoderus minutus Fabricius on DDT-treated and untreated bamboo splits

	LOT 4. SPRAYED ONCE (IMMEDIATELY AFTER CUTTING)			LOT 5. SPRAYED ONCE (ONE WEEK AFTER CUTTING)			LOT 6. SPRAYED TWICE (IMMEDIATELY AFTER CUTTING AND A MONTH LATER)		
	A Control	B DDT in kerosene	C Neocid	A Control	B DDT in kerosene	C Neocid	A Control	B DDT in kerosene	C Neocid
Age when first infested (weeks)	1	^a x	x	2-x	1-x	19-x	1-3	x	x
Age when infestation was heaviest (weeks)	9-11	x	x	12-x	13-x	19-x	11-x	x	x
Age when latest infestation was observed (weeks)	23	x	x	23-x	15-x	19-x	23	x	x
Average number of infestation holes per split.	169.6	0	0	57.3	11.0	0.7	151.3	0	0

^a x indicates pieces were never attacked

THE EFFECTS ON LOWLAND SOIL AS SHOWN BY RICE OF THE APPLICATION OF COPRA MEAL¹

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WITH TWO TEXT FIGURES

The quick response of Philippine cultivated soils to the addition of nitrogenous fertilizers reveals that our lands may be made more productive if they are supplied with the correct kind and amount of material capable of liberating available nitrogen. At present, the material used for this purpose is ammonium sulfate, which is expensive and not readily obtainable in the local market. A solution to this problem of the farmers may be found in the use of copra meal, which is commonly utilized as feed.

Copra meal, a by-product in the manufacture of coconut oil, is cheap and easily procurable in the provinces of Laguna and Quezon. For many years copra meal has been used as a source of protein in livestock rations. Because of its high protein and carbohydrate contents as found by Santos (1920) and Caray (1921), copra meal may be a good source of nitrogen and organic matter which are oftentimes the cause of infertility of Philippine soils. If copra meal could be used in place of imported nitrogenous materials for fertilizing lowland soil, it would be a distinct help to Filipino farmers growing lowland rice, as it would mean a more economical production. In addition, copra meal may have a ready market. Tabayoyong (1947) found copra meal to be beneficial to lettuce when applied at the rate of 100 grams for every 4.8 kgm. of Los Baños clay loam. Andrion (1948) reported that copra meal improved the chemical and biological properties of soils.

With the objects of determining the best amount of copra meal to apply to lowland soil and studying its effect on the growth, yield, and composition of the rice grains, the present study was conducted in the Department of Soils from December, 1946, to March, 1948.

MATERIALS AND METHODS

One hundred 1-gallon tin cans, each with a diameter of 15 cm. and a height of 18 cm., were used as culture pots. They were perforated at the bottom for drainage, and painted with coal tar to prevent rusting.

¹Experiment Station Contribution No. 1520; presented by the junior author as thesis for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture, March, 1948. Prepared in the Department of Soils under the direction of the senior author.

The soil was obtained from the lowland rice fields of the Experiment Station of this College. It was dried, pulverized, screened through a 5-millimeter sieve, and mixed thoroughly. Roots of weeds were removed. Five hundred kilograms of soil were apportioned to ten lots of ten replications each. Galvez (1936) found that the surface of the lowland soils of the Experiment Station contains 0.15 per cent nitrogen, 0.22 per cent phosphoric acid, 0.10 per cent potash, and 3.56 per cent organic matter. Barrera (1937) noted the same soil as Nanhaya clay. Aristorenas (1937) reported that the surface soil of Nanhaya clay has a maximum water-holding capacity of 66 per cent, a specific gravity of 1.38, a pore space of 67 per cent, a pH value of 7.4, a volume expansion of 31 per cent, and an available potash content of 0.02 per cent. Alvaro (1938) stated that the surface soil of Nanhaya clay has a sticky point of 37.25 per cent, a rolling-out limit of 31.89 per cent, a moisture content of 11.60 per cent, and a total phosphoric acid content of 0.12 per cent.

To each pot 100 grams of copra meal were added in lot I; 50 grams in lot II; 25 grams in lot III; 12.5 grams in lot IV; 6.25 grams in lot V; and 3.125 grams in lot VI.

The copra meal was obtained from the Department of Animal Husbandry of this College which purchased it from the San Pablo Oil Factory at San Pablo City. Sulit (1929) analyzed similar expeller product from the same oil mill and found that it contains 15.21 per cent moisture, 19.91 per cent fats and oil, 5.57 per cent ash, 34.25 per cent carbohydrates, 12.52 per cent crude fiber, and 16.63 per cent protein. With this percentage of protein content, the computed nitrogen it contains amounts to 2.6 per cent. According to Galvez, Moreno, and Lava (1928), Jaajoco, based on ash, found that copra cake contains 19.89 per cent P_2O_5 , and 8.14 per cent K_2O . In lot VII, 3.125 grams of copra meal and 0.4 gram of dissolved ammonium sulfate containing 20.6 per cent nitrogen were added. The pots in lot VIII were each fertilized with 0.4 gram of dissolved ammonium sulfate, and those in lot IX with a solution of 0.8 gram. No treatment was made to the pots in lot X, for the control. The pots were moistened with water and allowed to age for ten days. In order to simulate lowland conditions, the cans with the variously treated soil were placed in water in longitudinally divided 35-gallon gas drums.

An eleven-day-old Seraup Kechil 36 rice seedling was transplanted to each pot. The transplanted seedlings were allowed to recover their original vigor and then the pots were intermittently submerged in water during the growing period of the plants. When the plants were approaching maturity, the soil in the pots was kept moist only.

Weekly counts of tillers were made and recorded.

Before the crop was harvested, the average height of the plants was taken. The first harvest was done on December 25, 1947, or 178 days after seeding and the second was on January 15, 1948, or 189 days. Ocfemia and Calma (1948) reported that Seraup Kechil 36 matures in 163.4 days, gives a yield of about 41.40 cavans a hectare, and attains an average height of 137.79 centimeters. The yields were dried in the sun and freed from the unfilled grains. One hundred grains from each pot were weighed.

The determination of the ash and the total nitrogen of the grains was based on milled rice in accordance with the methods described by the Association of Official Agricultural Chemists (1945), and those of the phosphoric acid and potash, according to Morgan (1937).

RESULTS AND DISCUSSION

The plants in the different cultures showed conspicuous differences 29 days after they had been transplanted. Figures 1 and 2 show the appearance



Fig. 1—Rice plants 100 days old grown on Nanhaya clay to which varying amounts of copra meal and ammonium sulfate were added. Lot I, 100 grams of copra meal; lot II, 50 grams; lot III, 25 grams; lot IV, 12.5 grams; lot V, 6.25 grams; lot VI, 3.125 grams; lot VII, 3.125 grams plus 0.4 gram of ammonium sulfate; lot VIII, 0.4 gram of ammonium sulfate; lot IX, 0.8 gram of ammonium sulfate; and lot X, (Control), no treatment.

of the rice plants. The plants in the treated lots were taller, and had broader and darker leaves and more tillers and bearing culms than those in the control. The result tended to show that copra meal may be of value in Philippine soils for improving the development of rice plants. The improvements brought about were as good as, if not better, than those made by the ammonium sulfate fertilizer. In order to be of value, the nitrogen content of the copra meal should be made available sufficiently early so as to enable the plants to make use of it. The enhancement of growth corresponded to the amount of copra meal applied. Within certain limits, the higher the amount of copra meal added and consequently the greater the amount of nitrogen made available, the more apparent was the improvement upon the plants.

It is apparent in table 1 that, with the exception of lot I in which each pot received 100 grams of copra meal, the weight of 100 grains tended to be

a function of the amount of copra meal added. As the amount of copra meal was increased, a corresponding increase in weight was noted. This effect of the copra meal was well shown by each pot in lot II which derived 1.3 grams of nitrogen from the applied copra meal, 0.6 gram in lot III, 0.3 gram in lot IV, and 0.16 gram in lot V. The result also shows that when copra meal is used as a fertilizer, it should be applied with caution. Lower rates of application appeared not to have influenced the fertility of the soil.

It may also be noted in table 1 that the ash, nitrogen, phosphoric acid, and potash content of the milled rice follow a trend of results similar to that of the weight.



Fig. 2—Mature rice plants grown on Nanhaya clay to which varying amounts of copra meal and ammonium sulfate were added. Lot I, 100 grams of copra meal; lot II, 50 grams; lot III, 25 grams; lot IV, 12.5 grams; lot V, 6.25 grams; lot VI, 3.125 grams; lot VII, 3.125 grams plus 0.4 gram of ammonium sulfate; lot VIII, 0.4 gram of ammonium sulfate; lot IX, 0.8 gram of ammonium sulfate; and lot X, (Control), no treatment.

When the data of the lots treated with ammonium sulfate are compared with those treated with copra meal containing equivalent amounts of nitrogen, no apparent difference was revealed. A mixture of copra meal and ammonium sulfate was as good as, if not better, than ammonium sulfate alone.

SUMMARY

1. Under the conditions of the experiment, 50 grams of copra meal applied to 5 kgm. of Nanhaya clay loam soil was found most beneficial.
2. The higher rates of application of copra meal enhanced the growth of the rice plants, the weight of 100 grains, the mineral, and the nitrogen content of the milled grains.
3. Copra meal may be used in combination with or in place of ammonium sulfate fertilizer for ameliorating the fertility of soils.

RECOMMENDATION

Since copra meal is a Philippine product and available in any amount in the local markets, its use as a nitrogenous fertilizer should be given first consideration before any of the imported nitrogenous fertilizers. The use of copra meal will also help our coconut industry. Copra meal may be applied either alone or in combination with other fertilizers. Three experiments of the Department of Soils have shown that copra meal improves both upland and lowland soils. Because of the chemical nature of copra meal, soils may derive from it nitrogen and organic matter, the lack of which is often the main cause of the infertility of Philippine soils.

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TABLE 1
Summary table

LOT NO.	NITROGEN IN THE TREAT- MENT	MEAN NO. OF TILLERS	MEAN HEIGHT	MEAN WEIGHT OF 100 GRAINS	MEAN NO. OF BEARING CULMS	COMPOSITION OF THE RICE GRAINS			
						Ash Content	Nitrogen content	P ₂ O ₅ content	K ₂ O content
	<i>gram</i>		<i>centimeter</i>	<i>gram</i>		<i>per cent</i>	<i>per cent</i>	<i>mg/kgm.</i>	<i>mg/kgm.</i>
I	2.6	18.92	114.92	5.43	3.6	1.49	1.63	17.00	9.60
II	1.3	14.78	119.98	7.91	3.9	1.26	1.58	18.00	10.44
III	.6	12.02	104.20	5.06	3.5	1.27	1.69	19.98	16.50
IV	.3	7.04	101.43	4.26	3.3	1.22	1.39	20.30	16.60
V	.16	8.63	97.78	3.12	2.3	1.29	1.04	21.14	17.28
VI	.08	8.82	95.55	2.55	2.0	1.14	.88	12.00	9.10
VII	.16	10.63	97.77	3.35	2.0	1.12	1.47	17.28	10.57
VIII	.08	8.61	92.41	3.56	2.7	1.24	1.41	17.83	13.33
IX	.16	8.83	95.31	4.61	2.1	1.19	1.38	21.00	11.50
X	Control	8.71	83.03	3.38	2.4	1.11	.87	12.10	8.10

THE PRODUCTION AND SELECTION OF (P.B. 929 $\times$ POJ 2878) F₁ SEEDLING CANES¹

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The sugar cane arrow is a rich source of new forms of sugar cane. Harrison (1919) obtained 267 different sorts from one arrow of a variety of sugar cane that was not fertilized by another variety.

Mendiola (1921) noted an enormous variability in height, vigor, habit of growth, and stooling habit among no less than thirty varieties of sugar cane seedling hybrids he studied.

Unite (1925) reported that the young first and second generation seedling canes of the same age and parentage exhibited a wide range of variation in total number of shoots.

Sumagit² and Florida³ found among the seedling canes great variability in important agronomic characters from parent varieties.

Morales (1928), and Calma and Samonte (1947) likewise reported a high degree of variability in the weight, height and diameter of stalks, length of internodes, and number of millable and non-millable canes.

The writers' work on sugar cane improvement through production, selection and hybridization was conducted from October, 1943, to April, 1948, in the Department of Agronomy.

MATERIALS AND METHODS

Parentage of the seedlings. The cane seedlings came from arrows produced during the 1943-44 flowering season. The parents of these hybrids were POJ 2878 and P.B. 929, a hybrid between POJ 2878 and P.B. 363.

Hybridization. The flower of the arrow of POJ 2878 was used as male parent owing to the large amount of pollen its anther sheds. The Javanese method of pollination was followed. The arrow of the POJ 2878 cane

¹Experiment Station Contribution No. 1521. Read before the Los Baños Biological Club, College of Agriculture, on September 24, 1948.

²SUMAGIT, F. S. A study of the variability with respect to diameter of stalk, breadth of leaf, total solids, stooling, flowering, and color of (C.A.C. 87 $\times$ Negros Purple)F₁ seedling plants. (Thesis presented for graduation with the degree of Bachelor of Science in Agriculture, 1925. Unpublished.)

³FLORIDA, V. T. Variability in important agronomical characters among seedling canes from parent varieties H-227, Louisiana Striped, Cebu Purple, and Badila. (Thesis presented for graduation with the degree of Bachelor of Science in Agriculture, 1926. Unpublished.)

was cut, put in a bottle of water, and placed over the arrow of P.B. 929. The male and the female arrows were bagged together. The male arrow was replaced every other day for a week. The cane fuzz was considered mature when it began to fall off at a slight shaking of the cane stalk.

Seed germination and nursery care. In December, 1943, the seeds were collected and germinated in a seedbox of sterilized soil. The seedbed was watered regularly; to keep the soil moist all the time, the seedbox was covered with a piece of glass. When the seedlings were about three weeks old, they were watered with a solution of 15 grams ammonium sulfate to a liter of water. At the age of five weeks the seedlings were pricked in nursery plots near the Seniors' Social Garden at 20 cm. by 20 cm. apart.

Preliminary selection and culture of promising seedlings

Six months after pricking the seedlings, all of the vigorous seedlings were transplanted into plots at 50 cm. by 50 cm. apart. On August 10, 1946, or 25 months after the seedlings were planted in the plots, a preliminary selection of the promising seedlings was made. Only seedlings that had fairly large diameter of stalks and had 10 or more millable stalks to a stool were selected; the rest were discarded. Of the several hundred seedlings produced, only 36 were selected. From these, five cuttings, each with three viable buds, were prepared. The cuttings were planted in culture plots, 75 cm. apart in the row and 100 cm. between the rows. Only one cutting was planted in each hill. The plants were cultivated and weeded in the manner practiced in commercial cultures of sugar cane.

Harvesting and determination of variability among the seedlings. The seedling canes were harvested on April 4, 1948, or 18 months after planting. The millable and non-millable stalks were cut at the base close to the ground and the tops or points cut off. The variability in the number of millable and non-millable stalks in a stool, weight of millable stalks in a stool, and percentage of purity of the juice were determined.

In determining the apparent purity, five representative stalks of each seedling were taken. Each stalk was cut into three equal lengths of basal, middle, and terminal portions, crushed in a hand mill, and the juice analyzed for Brix and percentage of polarization with the use of a Bausch and Lomb saccharimeter. The analyses were made in the Department of Agricultural Chemistry.

RESULTS AND DISCUSSION

Field observations. When the preliminary selection was made on August 10, 1946, many stalks of most of the hybrids were dead, perhaps because the plants were allowed to grow for about twenty-five months on account of the unsettled conditions in the early part of 1945. At harvest a few of the stalks of the selected seedlings were dry and some were dead,

probably because the canes were overmature; 18 months had elapsed after planting.

The relative tillering power of the different hybrid seedlings was determined by counting the canes, including the dead and the non-millable ones. However, the dead stalks were not weighed and analyzed, so they were not included in the computation of the weight and apparent purity of the juice.

No major diseases were observed in any of the seedlings, though some leaf spots were present on several of them.

Variability in number of stalks. Table 1 shows the average number of millable and non-millable stalks in a stool of each of the different hybrid seedlings. The average total number of millable and non-millable stalks of each seedling cane varied from 5.50 to 32, with a population mean of 18.23. Of the 36 seedlings studied, 17, or 52.7 per cent, produced an average of 22.43 stalks, which was more than the population mean; 8, or 22.21 per cent, produced more than 22.43 stalks each. The total number of millable stalks of each seedling ranged from 2.5 to 17, with a mean of 10.61 (table 1). Twenty seedlings, or 55.5 per cent, produced more millable stalks than the population mean; of these, 9, or 25 per cent, had an average of 12.96. Table 1 also shows that practically all of the seedlings which produced a large total number of millable stalks likewise had a large number of living millable canes; the number of dead stalks varied from 1 to 6 only.

The average weight of the living millable stalks and the apparent purity of the juice are presented in table 2 which shows that the seedlings produced 3 to 14.8 kgm. of millable stalks each, with a mean of 8.26 kgm. Sixteen seedlings, or 44.4 per cent, exceeded the mean of millable stalks; 8, or 22.2 per cent, produced an average of 11.23 kgm. each.

Table 3, which presents the coefficient of correlation (r) between the number and weight of millable stalks of the seedling hybrids, shows a coefficient of correlation of 0.8221, which is highly significant.

The apparent purity of the juice of the different seedlings varied from 70.50 to 89.51 per cent, with a mean of 85.49 per cent. Eighteen seedlings, or 50 per cent, had each an apparent purity higher than 85.49 per cent. Some of the seedlings produced an average apparent purity of 87.43 per cent; 9, or 25 per cent of the seedling canes, an apparent purity of 87.53 to 89.51 per cent.

Selection of promising seedlings. The bases for selecting the promising seedlings of the hybrid canes were the weight of millable stalks and the apparent purity of the juice (table 4). Of the selected hybrids seedlings, numbers 6, 27, 28, and 33 gave each an average weight of millable stalks and apparent purity higher than the population mean. Seedling number 23 gave the highest weight of millable stalks and an apparent purity of the

juice higher than the population mean; number 42 ranked fourth in weight of millable stalks and had an apparent purity almost equal to the population mean.

SUMMARY

1. Hybridization was undertaken in order to combine in the hybrid plants the high sucrose content and large stalks of the female parent P.B. 929 and the high tonnage, high sucrose content, and resistance to major diseases of the male parent POJ 2878.

2. The hybrid seedlings showed a high degree of variability in the number of millable and non-millable stalks, weight of millable stalks, and apparent purity of the juice of millable canes.

3. From 36 seedlings, numbers 6, 23, 27, 28, 33, and 42 were selected and these are recommended for rapid propagation and for comparison of their performance with the standard varieties on the field scale.

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TABLE I

Average number of millable (living and dead) and non-millable stalks in a stool of the different hybrid seedlings

SEEDLING NUMBER	MILLABLE STALKS			NON-MILLABLE STALKS	GRAND TOTAL
	Living	Dead	Total		
	No.	No.	No.	No.	No.
33	15.00	2.00	17.00	15.00	32.00
42	13.00	3.50	16.50	8.00	24.50
23	12.33	2.30	14.63	3.66	18.29
6	12.50	1.50	14.00	5.50	19.50
34	8.00	6.00	14.00	14.00	28.00
29	12.20	1.60	13.80	11.00	24.80
17	10.50	2.50	13.00	5.50	18.50
13	9.00	4.00	13.00	2.00	15.00
37	7.26	5.70	12.96	10.00	22.96
—					
18	10.75	2.00	12.75	7.50	20.25
28	10.66	2.00	12.66	1.00	13.66
31	7.20	5.20	12.40	5.00	17.40
27	9.66	2.70	12.36	6.00	18.36
25	6.50	5.50	12.00	12.25	24.25
36	7.00	4.80	11.80	8.60	20.40
24	8.25	3.50	11.75	12.75	24.50
39	8.50	3.00	11.50	9.20	20.70
35	7.33	4.00	11.33	13.30	24.63
14	7.00	4.00	11.00	5.60	16.60
12	9.40	1.40	10.80	4.00	14.80
—					
40	4.50	6.00	10.50	6.20	16.70
30	6.00	4.50	10.50	10.00	20.50
11	6.40	4.00	10.40	7.20	17.60
26	7.00	2.70	9.70	5.00	14.70
9	8.00	1.00	9.00	7.40	16.40
32	6.00	3.00	9.00	4.33	13.33
21	5.50	3.00	8.50	8.50	17.00
22	6.00	2.00	8.00	6.00	14.00
41	5.66	2.30	7.96	4.30	12.26
19	5.75	2.00	7.75	11.50	19.25
5	5.00	1.00	6.00	8.66	14.66
4	3.50	2.50	6.00	9.00	15.00
3	4.33	1.60	5.93	8.00	13.93
2	4.75	1.50	5.75	2.75	8.50
38	3.50	2.00	5.50	12.50	18.00
1	0.00	2.50	2.50	3.00	5.50
Population mean.....			10.61		18.23
Mean of those above the popu- lation mean.....			12.96		22.43

TABLE 2

Average weight of millable stalks per stool and apparent purity of juice of the different hybrid seedlings

SEEDLING NUMBER	WEIGHT OF STALKS IN A STOOL	APPARENT PURITY
	<i>kgm.</i>	<i>per cent</i>
23	14.8	86.32
13	13.8	81.97
6	13.4	87.53
42	13.3	84.96
31	12.2	81.70
27	11.9	88.28
33	11.9	87.72
28	11.8	89.31
—		
29	10.5	85.39
34	10.4	81.01
35	10.3	82.40
12	9.8	80.86
26	9.5	86.45
18	9.0	88.66
17	8.7	87.28
19	8.5	84.87
—		
36	7.8	86.70
14	7.8	88.01
24	7.7	85.46
41	7.6	85.14
37	7.5	86.96
32	6.9	88.21
25	6.2	85.55
22	6.0	85.69
39	6.0	80.62
9	5.7	87.35
5	5.4	80.86
11	5.4	86.43
40	5.4	84.70
30	5.2	77.63
2	4.7	83.66
3	4.4	89.51
38	3.7	70.50
4	3.0	82.83
21	3.0	87.78
Population mean.....	8.26	85.49
Mean of those above the po- pulation mean.....	11.23	87.43

TABLE 3
Correlation table showing the coefficient of correlation (r) between the number and weight of millable stalks per stool of the different hybrid seedlings
Number of millable stalks per stool

V	3-3.99	4-4.99	5-5.99	6-6.99	7-7.99	8-8.99	9-9.99	10-10.99	11-11.99	12-12.99	13-13.99	14-14.99	15-15.99	f
3-3.9	2		1											3
4-4.9		2				1								2
5-5.9		1	1	2		1								5
6-6.9				3		1								4
7-7.9			1		3									5
8-8.9			1					1						2
9-9.9					1		1							3
10-10.9						1				1				3
11-11.9					1		1						1	3
12-12.9								1						1
13-13.9					1		1			1	1			3
14-14.9									0	3	1	0	1	1
f	2	3	4	5	6	4	3	3						35

Level of significance:
5% = 0.334
1% = 0.431

$r = 0.8221$

TABLE 4

Average data of agronomic characters of the selected hybrid seedlings

SEEDLING NUMBER	S T A L K S			WEIGHT OF MILLABLE STALKS IN A STOOL	APPARENT PURITY
	Millable	Non-Millable	Total		
	<i>No.</i>	<i>No.</i>	<i>No.</i>	<i>kgm.</i>	<i>per cent</i>
6	12.50	5.50	18.00	13.4	87.53
23	12.33	3.66	15.99	14.8	86.32
27	9.66	6.00	15.66	11.9	88.28
28	10.66	1.00	11.66	11.8	89.31
33	15.00	15.00	30.00	11.9	87.72
42	13.00	8.00	21.00	13.3	84.96

INDUCING MORPHOLOGICAL VARIATIONS IN CROP PLANTS WITH POISONOUS PLANT EXTRACTS¹

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WITH TWO TEXT FIGURES

In earlier experiments, Ko² found that when used as polyploidizing agents, the bark extracts from the arrow-poison plant, *Lophopetalum toxicum* Loher, and the dog-poison plant, *Rourea erecta* (Blanco) Merr., produced abnormalities in germinating seedlings of soybean. The writers' experiments were undertaken to study the toxic effects of these poisonous plant extracts on other species of crop plants. They were conducted in the Department of Agricultural Botany from December, 1945, to October, 1947.

According to Dieterle, Leonhardt, and Dorner,³ the bark of the stem of *Lophopetalum toxicum* contains a cyanogenetic glucoside called lophopetalin that amounts to 0.2 per cent.

The poisonous substance found in the bark of *Lophopetalum toxicum* is whitish to greenish in color.⁴ The poisonous substance is known to be used locally as arrow poison.

In *Rourea erecta* the substance used as dog poison is found in the seeds and in the roots. Ko⁵ was the first to report that the root extract of *Rourea erecta* induced in soybean seedlings the formation of multiple shoots.

EXPERIMENTS, RESULTS AND DISCUSSION

Preparation of the extract from the epidermal and inner bark of Lophopetalum toxicum. The bark near the base of the tree trunk was collected. The epidermal bark (periderm), a thin yellowish layer that is almost powdery in form, was separated from the inner bark which was pale salmon

¹Experiment Station Contribution No. 1522, taken from the thesis presented by the junior author for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture, October, 1947. Prepared under the direction of the senior author.

²Ko, W. F. Experiments on the induction of polyploidy in soybean by chemical and poisonous-plant-extract treatment. (Thesis presented in partial fulfilment of the requirements for the degree of Master of Science. 1944. Unpublished.)

³DIETERLE, H., H. LEONHARDT, and K. DORNER. 1934. Certain constituents in the trunk bark of *Lophopetalum toxicum*. Arch. Pharm. 272: 172-190.

⁴SULIT, M. D. 1938. Notes on some poisonous plants found in Mt. Makiling and vicinity (Arrow and dog poison). Philippine Jour. Forestry 1: 211-217.

⁵*Ibid.*

and fibrous near the sapwood. The epidermal and inner bark were separately pounded fine in a mortar.

The extract was obtained in two ways: with or without heat.

By boiling. To every 500 grams of each powdered bark, 2,000 ml. of water was added and boiled until thick. The juice was pressed out of cheese cloth. From this material, 200 ml. of juice was extracted and designated as the concentrated extract.

Without heat. Another concentrated juice of each bark was prepared by adding 500 ml. of water to every 450 grams of the powdered bark. The thick mixture was allowed to stand for 36 hours without heating. The extraction of concentrated juice was done in the same manner as in boiling. About 290 ml. of juice was obtained and designated as the concentrated extract.

Preparation of the root extract of Rourea erecta. The roots were collected from an old tree, cut into pieces and pounded into fine particles. To every 500 grams of the pounded material, 2,500 ml. of water was added and the mixture was boiled for 4 hours until it became a thick mass. High pressure was used to extract the concentrated juice. Two hundred fifty-two (252) ml. of juice was obtained from this material and designated as the concentrated extract.

Seeds of crop plants treated

Three classes of crop plants were used; namely, rice and corn for cereals; cowpea and mungo for legumes; and eggplant, pepper, and tomato for vegetables.

Method of seed treatment

Seeds of the crop plants used were soaked in the extracts of *L. toxicum* and the root extract of *R. erecta* at different concentrations and periods of time. The periods of immersion were as follows: 24 hours, 48 hours, and 72 hours. Rice and corn, however, were given the additional treatment of soaking the seeds for another 72 hours. This was done because of the thickness of the seed coat.

After the soaking, the seeds were washed in running water for 10 minutes and then sown immediately in prepared seedboxes.

Parallel culture of treated seeds and control plants. The treated seeds were planted in the seedbox side by side with the untreated or control culture. After germination, some of the abnormal seedlings were transplanted into cans for further observation.

Observation of germinated seedlings

The following observations were made from the culture in all sets of experiments: (1) number of seeds treated, (2) number of seeds germinated, (3) number of abnormal seedlings, and (4) percentage of abnormal seedlings.

Experiments with Lophopetalum toxicum

The four different kinds of extracts prepared from this species were tested separately for their effects on crop plants.

Legumes. Eight sets of experiments were treated separately with the extracts at different concentrations and lengths of time. The concentration of the extracts consisted of one part extract to one part water, one part extract to two parts water, one part extract to three parts water, one part extract to four parts water, and water alone for control. One hundred seeds of mungo and 50 seeds of cowpea were soaked in the extracts for 24 hours, and another 100 seeds of rice and 50 seeds of corn were soaked for 48 hours. Almost the same results were observed in a comparison of the extracts from the inner and the outer bark of *Lophopetalum toxicum* prepared by the two methods. Heating, therefore, did not destroy or reduce the effectiveness of the poison. It appears, however, that extraction without heating was not thorough. The data also show that the extract did not reduce much the percentage of germination.

The abnormal seedlings produced by soaking the seeds in one part extract to one part water and one part extract to two parts water differed from the normal seedlings in that their first pair of leaves were wrinkled and that the plants were stunted during their early growth.

It appears that 24 hours' soaking is sufficient to induce the formation of abnormal seedlings; the majority of the seeds that had been soaked for 48 hours had low germination.

Cereals. Two lots of 100 seeds of rice and 50 seeds of corn were soaked in one part extract to one part water. One lot was soaked in the extract for 48 hours, and the other lot for 72 hours. Except for the low germination, there was no direct effect of this extract on rice seeds. In corn the effect on the germinating seeds was very slight. There was no direct effect of the extract on the cereals, except that there was lower germination in treated plants than in the control, probably because the poisonous principle of the extract could not readily penetrate the hulls or seed coverings. The toxic effect of the extract from the bark of *Lophopetalum toxicum* was due to the cyanogenetic glucoside, lophopetalin, which, on hydrolysis, yields hydrocyanic acid.

Experiments with the root extract of Rourea erecta

The root extracts of this plant were tested separately on the three classes of crop plants in the same manner that *L. toxicum* was tested.

Legumes. Cowpea and mungo seeds were soaked separately in the different concentrations of the extract for 24 and 48 hours. A high percentage of abnormal seedlings was induced by this extract. Figure 1,

upper picture, shows two representative plants of cowpea (left) and mungo (right) with their control of the same age. All abnormal seedlings were transplanted to pots but they failed to grow beyond the cotyledon stage, except a plant from cowpea. The immediate effect of the root extract of

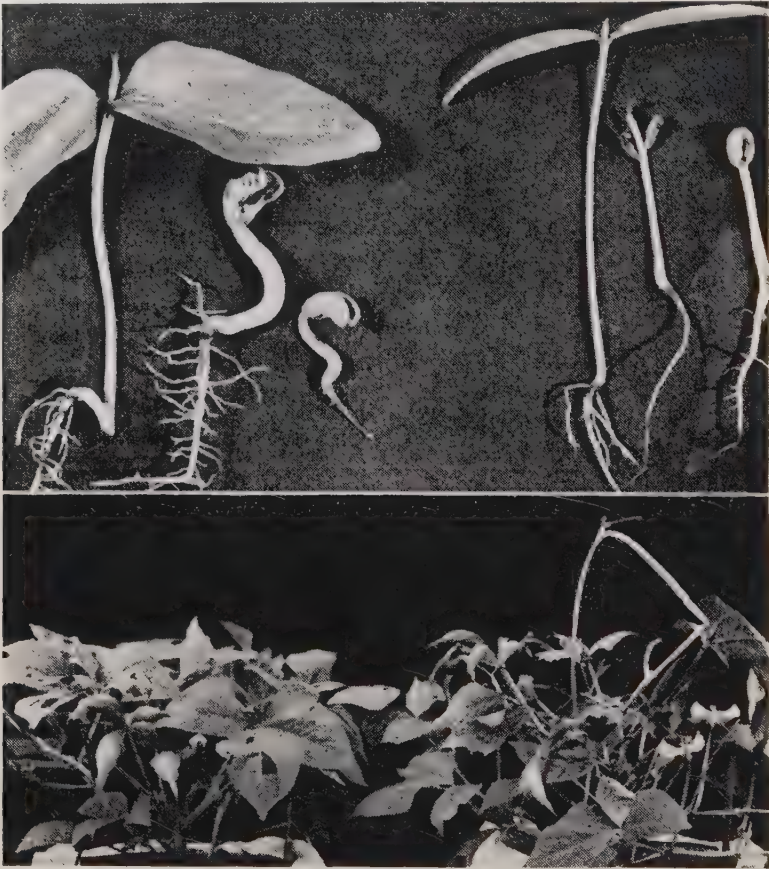


Fig. 1—Upper picture. Effect of *Rourea erecta* (Blanco) Merr. on cowpea. Left, the control and two other seedlings retarded in germination but with big stems induced by the treatment of one part extract to three parts water. Right, mungo seedlings, the control, and two other seedlings also retarded in germination but with big stems induced by treatment of one part extract to three parts water. Lower picture. Cowpea plant showing the difference in vegetative growth of the normal or control plant (right) and the variant (left) treated with one part of *Rourea erecta* extract and three parts water for 24 hours.

Rourea erecta on cowpea and mungo was the retardation and reduced percentage of germination of the seeds. It was noted that the higher the concentration of the extract, the lower was the percentage of germination of

treated seeds. In cowpea seeds that had been soaked in one part extract to one part water for 24 hours, the germination was only 4 per cent, but when soaked for 48 hours, no germination was obtained. In the case of mungo, a different result was obtained. In the experiments involving the use of a higher concentration of the root extract, a high percentage of abnormal seedlings of 76.92 to 96.34 in the 24 hours' immersion was obtained; whereas in the 48 hours' soaking, the percentage of abnormal seedlings was lower because of the low percentage of germination.

The best concentration for inducing the production of abnormal cowpea seedlings is one part extract to three parts water in 24 hours' soaking. In the 48 hours' soaking, the percentage of germination was low, even lower than that obtained in the control culture.



Fig. 2—Camera lucida drawings of strips of epidermis showing the stomata of normal (control) and variant (treated) cowpea plants.

The numerous abnormal seedlings produced by this treatment differed from the control in that they had swollen stems. The seedlings emerged five days later than the control. They were so much stunted in growth that it took time for their cotyledons to open after the seeds had sprouted (fig. 1 upper picture.) Before the first leaves appeared, proliferation of small shoots had developed from the same place where the first leaves would arise and remained stunted for a time until they finally died. Not a single case in mungo reached beyond this stage. These results seem to conform with Ko's in his experiment with soybean. In cowpea, one abnormal plant was able to survive and produce foliage leaves. It was very much stunted during its early growth, but after a month in the pot it grew normally and even surpassed the control in size of leaves (fig. 1 lower picture.) Microscopic examination of the epidermis of these leaves showed

that the stomata were bigger than those of the control (fig. 2). The mean differences of 5.60 for length and of 6.08 for width between the mean sizes of the stomata of the leaves of this lone surviving plant and of the control were highly significant.

This cowpea plant did not flower at the end of the experiment, but the control of the same age flowered 79 days from planting (fig. 1 lower picture). From its behaviour and cellular characteristics, this single abnormal plant was definitely a polyploid individual.

Cereals. Two sets of experiments were performed separately with the four dilutions of the extracts of *Rourea erecta* roots. One hundred seeds of rice and 50 seeds of corn were soaked in one part extract to one part water for 48 hours. In the control, the seeds were soaked in water alone for the same length of time. Another 100 grains of rice and 50 grains of corn were soaked in a similar extract for 72 hours. The root extract had no direct effect on rice seeds. The high concentration of the extract produced abnormal seedlings in corn which differed from the control in their stunted early growth. Later they grew so vigorously that they could not be distinguished from the control plants.

Vegetable crops. One hundred seeds each of tomato, pepper, and eggplant were soaked in one part extract and one part water for 48 hours. Except that the germination was lower than in the control plants, no abnormal seedlings resulted from the treatment. The experiment was not repeated with lower concentrations, since the seeds had not responded to the treatment with a higher concentration and long periods of immersion.

The poisonous substance of *Rourea erecta* which produced the detrimental effect on some crop plants has not as yet been determined.

Cellular characteristics of seedling variants

Stomatal size of normal and variants. In all sets of experiments that produced abnormal seedlings, no plants affected by *Lophopetalum toxicum* extract had leaves with bigger-sized stomata. On the other hand, no abnormal seedlings produced by treatment with root extract of *Rourea erecta* reached beyond the cotyledon stage, except in cowpea where one extremely abnormal seedling was able to survive. Microscopic examination of the epidermis of the leaves of this plant revealed its bigger stomata (fig. 2).

SUMMARY

1. Extracts from the stem-bark of *Lophopetalum toxicum* induced morphological variations in legumes but failed to produce mature abnormal plants. No effect was observed on cereals even if the grains were soaked for 72 hours in one part extract to one part water.

2. Root extracts of *Rourea erecta* induced the production of abnormal seedlings in cowpea and mungo at concentrations of one part extract to one part water, one part extract to two parts water, or one part extract to three parts water when seeds were soaked for 24 or 48 hours. All abnormal seedlings of mungo failed to reach beyond the cotyledon stage. In cowpea, seeds were soaked in a concentration of one part extract to three parts water for 24 hours. One out of 20 abnormal seedlings was able to reach the vegetative stage. The only effect of the extract observed on the vegetable crops studied was the low percentage of germination.

3. One marked variant cowpea was produced when seeds were soaked in the extract from the root of *Rourea erecta* at the concentration of one part extract to three parts water. This was definitely a polyploid type as indicated by the stomatal size and the delay in vegetative growth. Compared with the control, which had already set pods, this variant did not flower at the age of two and a half months.

A PREWAR STUDY OF THE AVAILABILITY OF PUBLIC-SCHOOL EDUCATION TO CHILDREN IN THE BARRIOS OF BAY AND CALAUAN, LAGUNA¹

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One of the important agencies for improving the economic and social conditions of the people is the school system. The opportunity of the rural children to acquire education is often hampered by the lack of educational facilities. A study was made before World War II of the availability of public education in rural communities in order that the educational needs of the rural population could be better understood. On the basis of those needs, an appropriate program of rural education could be formulated.

Osias² considers the school as the outstanding institution for individual and social uplift in the rural community. He also states that the barrio children do not have the same educational opportunities as the children in the town or city because of the absence or inaccessibility of barrio schools.

In the United States, according to Brim³, half of the public-school enrollment was in one-teacher and hamlet schools. He further stated that the children attending these schools were handicapped as regards length of attendance and high-school opportunity.

Butterworth⁴ ascribes the cause of inferior facilities in small schools in the rural districts to the indifference of the rural population to the school problem.

Caliver⁵ found that the schools for Negroes in the rural districts of the United States were far from the home of the children. In a more extensive study published in 1935, Caliver⁶ found that a large proportion of children lived far from school. In these studies, Caliver considered 1½ miles (2.4 kilometers) as the reasonable maximum distance which children

¹Experiment Station Contribution No. 1523.

²OSIAS, C. 1921. Barrio life and barrio education. ix + 174 p. New York: World Book Company.

³BRIM, O. G. 1925. Rural education. xxi + 302 p. New York: The MacMillan Company.

⁴BUTTERWORTH, J. E. 1926. Principles of rural school administration. xvi + 379 p. New York: The MacMillan Company.

⁵CALIVER, A. 1933. Rural elementary education among Negroes under Jeanes supervising teachers. U. S. Dept. Int., Off. Educ. Bull. 5: 1-57.

⁶CALIVER, A. 1935. Availability of education to Negroes in rural communities. U. S. Dept. Int., Off. Educ. Bull. 12: 1-86.

may walk to school without prejudice to their health and to their educational progress. Caliver concluded that the farther the younger children live from school, the more likely they will drop out on account of distance.

This investigation was made to study: (a) the availability of public school facilities in the barrios of Bay and Calauan, Laguna; (b) accessibility of these facilities to the children in the barrios; and (c) amount of formal education received by the barrio children.

MATERIALS AND METHODS

This survey was performed in nine barrios of Bay and seven barrios in Calauan, Laguna. The study covered 1,053 children in 604 families residing in the barrios of Bay, and 798 children in 544 families residing in the barrios of Calauan.

Personal interviews with the people in the barrio were made. A survey form, prepared in the Department of Agricultural Education, was used in securing the data.

The study was started in 1940 and was completed in 1941.

RESULTS AND DISCUSSION

Description of area surveyed

The municipality of Bay comprises nine farm villages and the poblacion. It had a population of 6,703 in 1939, most of which were residing in the rural districts. The poblacion is located along the provincial highway of Laguna. It is about 1 kilometer to Calo, San Isidro, and Dila, 2½ kilometers to San Antonio and Maitim, 4 kilometers to Puypoy, 7 kilometers to Tranca, 8 kilometers to Sta. Cruz, and 12 kilometers to Bitin. Only the barrios of Maitim, Calo, and Puypoy are traversed by the provincial road; the others are connected to the poblacion by dirt roads or trails.

Besides the central school in the poblacion which offered complete elementary instruction, schools had been established in four barrios, namely: San Antonio, Tranca, Bitin, and Maitim. The schools in San Antonio and Tranca offered four primary grades. There were only first and second grades in Bitin and Maitim.

Calauan had a population of 7,302 in 1939. The municipality is mainly a rice- and coconut-growing locality. It is traversed by the provincial road. Of the seven barrios surveyed, five are reached by macadam roads. These are Dayap, Lumot, Emoc, Balayhañgin, and Masiit. San Isidro is connected to the poblacion by a dirt road, and Limao has no highway leading to the poblacion.

In addition to the central school in the poblacion, two barrios, Dayap and Limao, had each a barrio school offering the first and second grades.

Occupational composition of residents

The people living in the barrios of Bay and Calauan were engaged in a wide variety of occupations; about 36 occupations were represented. The majority, however, were pursuing agricultural activities. Of the 1,148 household heads studied, 47.4 per cent were farmers and 24.7 per cent were farm laborers, or a total of 72.1 per cent. The next important occupation was fishing, in which 9.5 per cent of household heads were engaged. This large percentage was due to the fact that several barrios are either on or near the shores of Laguna de Bay. The other occupations were represented by a few household heads, the more important ones being those of the merchant, storekeeper, carpenter, rig driver, tailor, and launderer.

Sex and age of children

Of the 1,851 children included in this study, 49.8 per cent were male and 50.2 per cent, female. These children were classified into two groups; namely, 7 to 14 years old, which numbered 1,242, and 15 to 24 years old, which numbered 609.

Of the 1,242 children whose ages ranged from 7 to 14, 48.9 per cent were male and 51.1 per cent, female. The seven-year-old children were the most numerous, comprising 18.1 per cent of the entire number.

Of the 609 children whose ages ranged from 15 to 24 years, 51.7 per cent were male. There was a tendency for the number of children in each age group to decrease as the age increased.

Proportion of children of school age attending school

Of the 1,242 children of elementary-school age studied, 64.4 per cent were attending school (table 1). The percentage for the male children was 67.6, or slightly higher than that for the female, which was 61.3. It was observed that the percentage of in-school children gradually became smaller as the age increased. The percentage of attendance of the boys dropped slightly after reaching the age of twelve, but the drop in attendance of the girls after this age was greater. Among the older individuals 15 to 24 years old, a much smaller percentage was attending school. Of the 609 individuals, 9.5 per cent were still studying. The percentage of attendance among the male children was 11.2 per cent, which was higher than the 7.7 per cent among the female. This indicates a tendency for the female children to leave school earlier than the male.

Grades completed by out-of-school children

The 7- to 14-year-old children who had stopped studying completed one grade on the average. There was a slight difference in the schooling of the male and of the female children, the percentage being 0.9 and 1.1,

respectively. It was found that a large number of boys and girls who had reached school age did not attend any school. This lowered the average grade completed by the children in this age group. Among school children who attended school and then dropped out, a large number finished the third grade.

Of the out-of-school individuals 15 to 24 years old, the average number of grades completed was 2.2. The boys completed 2.5 grades, which was higher than the 2.0 grades completed by the girls. Among the out-of-school individuals in this age group, the greatest number finished the fourth grade. On the whole, the low average grades completed by those who were out of school was due to the large number of individuals who never went to school.

Reasons for leaving school

The reasons stated by out-of-school individuals 7 to 24 years old for leaving school are given in table 1. A big majority of the individuals studied, comprising 58.2 per cent, gave inadequacy of financial means as the principal cause. The parents did not have sufficient earnings to support the family and at the same time send the children to school. By dropping from school, the children could help their parents and the money for school expenses could be used for the home instead.

Poor health was also mentioned by 12.8 per cent of the children as the main cause for leaving school. Another significant reason given by the children was the distance of the school from their homes, for some barrios did not have school facilities. The other important reasons mentioned were the following: poor grades, 5.2 per cent; needed at home, 4.3; lack of room, 3.4; and lack of interest, 3.1. In the places surveyed, the majority of the people were farmers or farm laborers. They depended almost entirely on the crops that they raised for subsistence. Because of inadequate income from other sources, they did not have sufficient financial means to keep their children in school for a long period.

Effect of distance on persistence in school

As shown in table 1, the distance of the school from the home had an adverse effect on persistence in school of children of elementary-school age. In the case of the children whose homes were less than one kilometer from the school, 29.5 per cent were out of school. The percentage of out-of-school children increased with the increase in distance; of those living four kilometers or more from the school, 57.3 per cent were out of school. The figures further show that slightly more female pupils than the male dropped out of school, except among those living 2.0 to 2.9 kilometers from the school. In the latter group, the percentage of female children who were out of school was almost the same as that of the male.

SUMMARY

1. The majority of the people in the barrios of Bay and Calauan were engaged in agricultural pursuits. About 47.4 per cent were farmers and 24.7 per cent, farm laborers, or a total of 72.1 per cent. A substantial proportion, comprising 9.5 per cent, was engaged in fishing. This was due to the proximity of several barrios to Laguna de Bay.

2. Six of the seventeen barrios studied were provided with schools offering two to four grades.

3. Of the children whose ages ranged from 7 to 14 years, 64.4 per cent were attending school. The percentage for male children was slightly higher than that for female.

4. Of individuals 15 to 24 years old, 9.5 per cent were still in school. The percentage for the males was also slightly higher than that for the females.

5. The average grade completed by children of elementary-school age who were out of school was 1.0.

6. Among the boys and girls 15 to 24 years old who were out of school, the average grade completed was 2.2. The boys received a slightly higher amount of education than the girls.

7. The principal reason for dropping out of school was the lack of financial means. Poor health and distance were also mentioned as primary causes by almost one fourth of the children studied.

8. There was a definite tendency for the percentage of out-of-school children to rise with the increase in distance between the school and the homes.

TABLE 1

School attendance and educational achievement of children in the barrios of Bay and Calauan, Laguna

	MALE	FEMALE	BOTH SEXES
Total number of children studied.....	923	928	1851
Children classified:			
7-14 years old.....	608	634	1242
15-24 years old.....	315	294	609
Percentage in school of children 7-14 years old.....	67.6	61.3	64.4
Percentage in school of sons and daughters			
15-24 years old.....	11.2	7.7	9.5
Grades completed by out-of-school children			
7-14 years old.....	0.9	1.1	1.0
Grades completed by out-of-school sons and			
daughters 15-24 years old.....	2.5	2.0	2.2
Percentage of children out of school when			
distance of school from home is:			
.9 km. or less.....	27.0	32.2	29.5
1.0-1.9.....	38.6	41.6	40.0
2.0-2.9.....	41.9	42.0	41.9
3.0-3.9.....	48.7	51.8	50.2
4.0 and over.....	52.0	63.2	57.3
Principal reasons for leaving school:			
Financial.....	60.8	55.2	58.2
Poor health.....	8.4	18.1	12.8
Far from school.....	12.1	11.6	11.9
Poor grades.....	5.3	5.0	5.2
Needed at home to help parents.....	4.2	4.4	4.3
Lack of room.....	3.7	3.1	3.4
Lack of interest.....	4.1	1.8	3.1

EFFECT OF MASS SELECTION OF THE SEED AND OF SEASON OF PLANTING ON THE YIELD OF THE SOYBEAN¹

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WITH ONE TEXT FIGURE

A study to determine whether or not better yields may be obtained by using in the wet-season planting, seeds selected from the crop grown in the wet season instead of those from a crop in the dry season, was conducted in the laboratory of the Department of Agronomy and in the fields of the Experiment Station from November, 1946, to April, 1948.

In regard to the seed of the soybean, Rodrigo (1947) reported that because it is rich in oil, its viability in the tropics does not last long.

Burlison, Van Doren, and Hackleman (1940) found that the soybean seed rapidly lost its viability when stored for more than two years, although the average yield of all varieties from one-, two-, and three-year-old seeds was only slightly less than that from new seeds. These authors noted, however, that the yield sharply decreased when the seed had been stored for four years or longer. These authors further stated that poor stands of soybeans, resulting from the use of old or improperly stored seed, had been frequent in Illinois.

Zahnley (1942) reported that the soybean seed loses its viability very much more rapidly than most other legumes; hence, it is seldom advisable to plant seed which is more than one year old.

CULTURE I

On November 20, 1946, 400 plants of the Head Green variety of soybean were mass selected from the 1946 wet-season field culture of the Division of Annual Farm Crops. The mass selected plants were cut at the base, brought to the laboratory, dried, threshed, and cleaned, and the seed of individual plants weighed. All seeds of plants with the same weight as or greater than the mean weight of all the plants were considered as mass selected seeds.

The remaining seeds of the 400 selected plants were taken to determine the percentage of mass selected seeds.

¹Experiment Station Contribution No. 1524. Prepared from the theses of the junior authors presented for graduation with the degree of Bachelor of Science in Agriculture in April, and June, 1948, respectively.

Sample seeds of 400 unselected plants from a different lot in the same field were taken to serve as control for the wet-season series. All seeds were dried and stored in airtight containers.

The same procedure was followed in preparing the seeds for the 1947 wet-season planting.

To determine the viability of the seeds, a germination test of samples of the different seed materials was made in the laboratory. Before the selected and control seeds of the 1946 wet-season crop were stored on December 31, 1946, a germination test of 100 seeds was made. Another germination test of 300 seeds was made before planting on June 4, 1947.

Cultures were made of the selected 1946 wet-season crop, the selected 1946-47 dry-season crop, the controls of the 1946 wet-season, and the 1946-47 dry-season plantings. Each culture occupied about 600 sq. m. of land which was divided into three plots. The replicated plots were distributed at random.

Four to five seeds were planted in hills 30 cm. apart in furrows 80 cm. from each other. Two weeks after planting, all missing hills were replanted and about three weeks after germination, the plants were thinned to two vigorous seedlings in each hill.

The percentage of germination was determined by examining 100 hills at random in each plot and counting the hills with emerged seedlings. Likewise, the stand of the plants was determined by examining 100 hills at random in each plot. The external appearance of the plants was also noted.

When the plants were eight to twelve centimeters high, or 22 days old, a three-tooth cultivator drawn by a carabao was passed between the furrows to kill the weeds. The last cultivation or hilling up was done on July 3, 1947. The cultures were weeded whenever necessary.

The crop was harvested when 90 to 95 per cent of the pods of the plants were mature. The plants were cut at the base. The harvest from each plot was dried, weighed, and threshed separately. Part of the harvest was threshed by man and part with a combine. Since threshing with the combine was more efficient than by man, those that had been threshed by man were threshed again with the combine. The clean seeds from each plot and the straw were weighed.

CULTURE II

The control and selected seeds for the 1946-47 dry-season crop were obtained from culture I. For the wet-season crop, 400 plants were mass selected from the field planted to unselected seeds; the criteria of selection were the appearance and height of the plants and the number of pods.

These plants were harvested and brought to the laboratory where they were dried, threshed individually and cleaned. The seeds of each plant were weighed and all seeds of plants with the same weight as or greater than the mean weight of the seeds of the 400 plants were mass selected for seed.

The seeds of 400 other plants taken at random served as control for the wet-season crop.

All seeds of individual plants were dried and stored in airtight containers.

The viability of the seeds was tested in four sowings of 20 seeds each, 10 for the selected set and 10 for the control. The first sowing was on October 8, 1947; the other three followed at three days' interval.

Seeds of the wet-season series were tested for viability a week after harvest. Only three sets of sowing at three days' interval were used.

The cultures of the selected 1946-47 dry-season crop and its control, and those of the selected 1947 wet-season crop and its control were run each on three plots distributed at random. The land was furrowed 75 cm. apart. On November 12, 1947, four to five seeds of the 1947 wet-season seeds were planted in each hill 30 cm. apart in the furrows. As the 1946-47 dry-season seeds had a very low percentage of germination in the laboratory test, 10 to 14 seeds were dropped in each hill. All missing hills were replanted eleven days after planting; when the seeds failed to sprout for the second time, seedlings were transplanted from crowded hills. On December 8, 1947, or 25 days after planting, the plants were thinned to two vigorous seedlings a hill.

The percentages of germination and stand of plants in the field were obtained from 100 hills taken at random from each plot.

As cultivation with the plow could not be done after thinning because the growth of the plants was rather slow, the seedlings were cultivated with garden hoe and trowel. The plots were cultivated 29 days after planting; six days later, they were hilled up with a wooden plow. Weeding was done when necessary.

On February 23, 1948, the plants, then mature, were harvested plot by plot, threshed separately, dried, and weighed. The dry-season control culture was harvested later because the replants did not mature at the same time as the main crop.

RESULTS AND DISCUSSION

. *Percentage of mass selected seeds.* The total weight of the seeds of the 400 selected plants in the 1946 wet-season soybean crop was 5503.40 grams, with a mean of 13.75 grams. One hundred fifty-one plants, or 30.77 per cent, gave a mean yield of 13.75 grams and above. In the 1946-47 dry-

season crop, the total weight of the seeds of the 400 selected plants was 2785.20 grams. A total number of 173 plants, or 40.32 per cent, gave a mean yield of 6.96 grams and over.

In the 1947 wet-season crop, the total weight of the seeds of the 400 selected plants was 18,936.5 grams, with a mean of 47.37 grams. A total of 177 plants, or 44.25 per cent, gave a mean yield of 47.37 grams.

Germination test in the laboratory. In the germination test on December 31, 1946, before the seeds were stored, the selected and control seeds of the 1946 wet-season crop gave 92.0 and 98.0 per cent germination, respectively. When tested on June 4, 1947, after 155 days of storage, the selected and the control seeds gave only 74.7 and 76.3 per cent germination, or a decrease of 17.3 and 21.7 per cent, respectively. However, the selected and control seeds of the 1946-47 dry-season crop which were tested on June 4, 1947, before they were planted, gave 89.6 and 88.6 per cent germination, respectively. These seeds were harvested on May 1, 1947 and had been stored for 34 days when the germination test was made. After 164 days in storage, the seeds had a germination of 37.5 and 17.5 per cent, respectively, showing a considerable loss of viability in storage.

The 1947 wet-season selected and control seeds were fresh, and they gave 100 per cent germination a week after harvest, or before they were planted.

The results indicate that the soybean seed loses its viability rapidly in storage as noted by Burlison, Van Doren, and Hackleman (1940), Zahnley (1942), and Rodrigo (1947).

Germination and stand of plants in the field. In culture I the germination of the different seed materials varied significantly. The selected and control seeds of the 1946-47 dry-season crop had practically the same percentages of germination, with a mean of 93.6 and 93.0 per cent, respectively. Likewise, the selected and control seeds of the 1946 wet-season crop had practically the same germination, with a mean of 84.3 and 83.3 per cent, respectively. The results in this planting indicated that mass selection did not improve the germination of the seeds. However, the selected and control seeds of the 1946-47 dry-season crop gave significantly higher percentages of germination than those of the 1946 wet-season crop.

There was no significant difference in the stand of the plants of the different seed materials in the field. The selected and control seeds of the 1946-47 dry-season crop gave a mean stand of 99.16 per cent, practically the same as the 98.0 per cent of the 1946 wet-season crop. Since all missing hills were replanted, it was expected that the different seeds would give practically the same stand. However, more replantings were made in the 1946 wet-season crop on account of the poor germination. The plots planted

to seeds of the 1946-47 dry-season crop gave a high percentage of germination; hence, only few vacant hills were replanted.

In culture II the percentages of germination of the selected and control seeds of the 1946-47 dry-season culture were very low, 19.28 and 7.39 per cent, respectively. It was noted that mass selection had improved markedly the germination of soybean seeds. The selected and control seeds of the 1947 wet-season culture had an average germination of 79.82 and 75.40 per cent, respectively. The difference between the germination of the seeds of the 1946-47 dry-season control and that of the 1947 wet season was highly significant in favor of the latter. The percentage of germination of the selected dry-season seeds was also much lower than that of the selected seeds of the 1947 wet-season culture. These results are similar to those in the laboratory test, and the writers attribute them to the long storage of the seeds of the 1946-47 dry-season crop. The results also indicate that it is not profitable to produce soybean seeds in one season for planting in the same season of the following year. The results further show that the mass selection of the 1947 wet-season crop had no effect on the percentage of germination.

That the germination of the seeds in the field was much lower than that in the laboratory may possibly be due to the typhoon that occurred three days after the seeds had been planted. The heavy rain leveled the furrows and covered the seeds with a thick layer of mud which hardened in the sun and prevented the seedlings from emerging. Rodrigo (1947) reported that the period of germination of the soybean is the most critical stage in the development of the plant and that excessive moisture is disastrous. According to Beeson (1944), soybean uncurls in germination and lacks the force to bore through a crust of considerable depth. In the writers' work, the hardened soil prevented the emergence of the seedlings, as shown by the undeveloped germinated seeds which were dug up during the replanting of the empty hills.

The writers noted a very highly significant difference in the stand of the plants of each seasonal culture. The stands from the 1947 wet-season seed materials were practically the same, 99.0 and 97.3 per cent for the selected and control seeds, respectively. The control seeds of the 1946-47 dry season gave an average stand of 42.0 per cent, whereas the selected seeds gave 85.0 per cent. The low stand of the dry-season control culture was largely due to the low viability of the seeds; many hills remained unproductive in spite of several replantings and transplantings.

Vegetative vigor of the plants. The plants from the different seed materials grew vigorously and uniformly from the seedling stage to maturity. They did not have any tendency to lodge, except after a typhoon on August

11, 1947. When the plants were mature, they were completely defoliated; only the ripened pods persisted on the stems.

In the 1947 wet-season plantings, the selected and control seeds produced plants that were uniform in growth and more vigorous than those from the selected and control seeds of the dry season. The selected seeds of the 1946-47 dry-season culture produced more vigorous plants than the control seeds. Figure 1 shows the marked differences in appearance



Fig. 1—The stand in the field of the plants of the different cultures 99 days after planting. Note the poor stand of plants at the right of the control and selected seeds of the 1946-47 dry-season crop.

of the plants of the different cultures; the plants of both selected and control seeds of the 1947 wet-season crop were taller than those of the 1946-47 dry season. The plants from the selected wet-season seeds, with an average height of 41.3 cm., were significantly taller than those of any of the other three cultures. Although the plants from the wet-season control seeds were taller than those of the 1946-47 dry-season control, the difference was not significant. The plants from the selected seeds of the 1946-47 dry-season crop were taller than the control of the same season, but the difference was also insignificant.

Susceptibility to pests and diseases. Cultures I and II were not bothered by diseases. However, a month after planting the seeds in culture I in the field, red ants and aphids infested some of the plants of the different treatments, but their damage was negligible.

When the plants in culture II were 15 to 20 cm. high, small caterpillars damaged the leaves by rolling and eating them. From this stage up to flowering and before maturity, several insects (a few *Phaneroptera furcifer*, *Nezara viridula* Linn.) and red ants and aphids infested some plants of the different cultures, but the damage was likewise negligible.

Flowering and maturing stages. In all treatments in culture I, flowers appeared in about 30 days after the seeds had been planted. The plants were not in full bloom until after 40 days; they were harvested on October 19, 1947, or 116 days after planting.

In culture II, flowers appeared in the selected dry-season, the selected wet-season, and the control wet-season plantings on December 24, 1947, or 41 days after seeding. Twenty-one days later, almost all of the plants except the replants were in full bloom. On January 20, 1948, most of the plants were developing pods. At the age of 103 days the plants were fully mature. The harvesting of the dry-season control culture was delayed owing to the uneven growth of the plants.

Yields of seeds and straw. In culture I a comparison of the two methods of threshing, by man and by the combine, to determine the efficiency of each showed that, on the average, the combine is 87.0 per cent more efficient than the man-method of threshing. About 228.756 kgm. of seeds a hectare were saved by the combine and the work was accomplished much faster than by man. Both of these advantages are important in the mechanization of soybean culture.

There was no significant difference among the yields of seeds from the different seed materials, indicating that the selection of seeds for a definite season did not affect seed production. The yield of straw showed the same trend as the seeds; mass selection did not materially affect the production of straw.

In culture II the 1946-47 dry-season control and selected seeds gave an average yield of 5.9 and 7.8 kgm., respectively, in the 1947-48 dry-season crop. These yields were significantly lower than those of either the control or the selected seeds of the wet-season plantings. The results show that mass selection significantly increased the yield of soybeans.

The actual yields of straw, in kilograms, from the different seed materials indicated that mass selection increased the yield. There was a significant difference between the cultures of the two opposite seasons in yields of seed and of straw. The low yields from the 1946-47 dry-season seeds were due to very poor viability.

On the whole, the writers' results showed that mass selection in soybean in the same season did not affect the yields of seed and straw. These results corroborate the findings of Burlison, Van Doren, and Hackleman (1940) that the average yield of all varieties from the one-, the two-, and the three-year-old seeds was only slightly less than the yield from new seeds.

Computed yields of seeds and straw for every hectare

Table 1 shows the actual and computed yields of seeds in a hectare of the different seed materials in culture I. The selected seeds of 1946-47

dry-season and 1946 wet-season crops gave average computed yields of 1,932.69 and 2,088.46 kgm., or 36.46 and 38.40 cavans of seeds a hectare, respectively. The average computed yields of the control of 1946-47 dry-season and 1946 wet-season crops were 1,659.18 and 1,633.82 kgm., or 31.30 and 30.82 cavans of seeds a hectare, respectively.

The computed yields of straw of the selected soybean seeds of the 1946-47 dry-season and 1946 wet-season crops were 5,016.668 and 5,149.620 kgm., respectively; whereas the controls of 1946-47 dry-season and 1946 wet-season crops gave 4,662.372 and 5,433.710 kgm., respectively.

Computed yields of seeds and straw for every hectare

Table 2 shows that in culture II the selected and control seeds of the wet-season crop gave computed mean yields of 552.58 and 487.67 kgm., or 10.18 and 8.99 cavans of seeds a hectare, respectively. The computed mean yields of the selected and control seeds of the 1946-47 dry-season seeds were 372.08 and 280.25 kgm., or 6.85 and 5.17 cavans a hectare, respectively.

In yields of straw the selected and control seeds of the wet-season crop gave mean yields of 546.25 and 427.5 kgm., respectively; whereas the selected and control seeds of the 1946-47 dry season gave averages of 299.25 and 218.5 kgm., respectively.

SUMMARY

1. In culture I the 1946-47 dry-season selected seeds had 89.6 per cent germination and the control seeds, 88.6. The seeds of the 1946 wet-season selected seeds had 74.7 per cent and the control seeds, 76.3 per cent. The selected and control seeds of the 1946-47 dry season had significantly higher percentages of germination in the field than the selected and control seeds of the 1946 wet-season crop. This difference is attributed partly to the long storage of the seeds.

In culture II the 1946-47 dry-season selected seeds had an average germination of 19.28 per cent in the field and the control seeds, 7.39 per cent; the 1947 wet-season selected seeds had 79.82 per cent and the control seeds, 75.49 per cent. The selected and control seeds of the 1947 wet-season crop had a significantly higher percentage of germination in the field than the 1946-47 dry-season crop. This difference is also attributed in part to the long storage of the seeds.

2. In culture I the yields of seeds and straw were not affected by mass selection for the season in which the seeds were selected, indicating that in soybean, mass selection is of no avail in enhancing yields.

In culture II the wet-season seeds yielded significantly more seeds and straw than the 1946-47 dry-season crop. The effect of mass selection

in the wet-season crop is small, although the mass-selected seeds of the 1946-47 dry-season crop gave a significantly higher yield than the control seeds.

3. The data show definitely that in soybean, mass selection of seeds suited for seasonal planting does not seem to accrue any appreciable benefit. The loss of viability of the seeds in storage appears to be the controlling factor. The wet-season selected seeds invariably gave higher yields of seed and straw than the dry-season selected ones when planted during the dry season. In this sequence of planting, the wet-season selected seeds were still fresh, whereas the dry-season selections were old with reduced viability.

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TABLE 2
Actual and computed seed yields in kilograms and in cavans of the different seed materials (1947-48 dry-season planting)

SEED MATERIAL	ACTUAL YIELD				COMPUTED YIELD TO A HECTARE			
	PLOTS			Average	PLOTS			Average
	1	2	3		1	2	3	
Selected seeds, 1946-47 dry season	5.9	7.8	9.8	7.83	280.25	370.50	465.50	372.08
Selected seeds, 1947 wet season	9.4	12.8	12.7	11.63	446.50	608.00	603.25	552.58
Control seeds, 1946-47 dry season	5.3	6.5	5.9	5.90	251.75	308.75	280.25	280.25
Control seeds, 1947 wet season	8.6	11.5	10.7	10.27	408.50	546.25	508.25	487.67
								kgm. cavans

A FURTHER STUDY ON THE INFLUENCE OF IPIL-IPIL (*LEUCAENA GLAUCA* LINN.) SEED MEAL IN A RATION FOR GROWING CHICKS¹

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In a previous paper, Pizarro (1947) reported that ipil-ipil (*Leucaena glauca* Linn.) seed meal could not be recommended as the principal source of protein supplement in rations for chickens in spite of its high protein content. He found that chicks fed with a ration containing 20 per cent ipil-ipil seed meal as sole protein supplement were pale, thin, and rather small for their ages.

Despite this seemingly adverse effects of ipil-ipil seed meal, the use of this legume seed as a source of protein in poultry rations deserves a more intensive study because of its high protein content and availability in most places in this country. The present study, therefore, was undertaken in the Department of Animal Husbandry from June, 1947, to February, 1948, to determine further the influence of ipil-ipil seed meal in a ration for growing chicks.

MATERIALS AND METHODS

Stock. A total of 204 chicks artificially hatched from eggs laid by the College flock were used in the study. The stock was composed of 118 Los Baños Cantonese and 86 New Hampshire chicks. The chicks in each breed were equally divided into two lots and observed separately for a period of twelve weeks, one lot serving as control and the other as the experimental lot.

Ration. The rations used were composed of the following ingredients, all parts by weight:

FEEDS	LOT I	LOT II
Fine rice bran.....	55	55
Ground corn.....	20	20
Shrimp meal.....	20	15
Copra meal.....	5	5
Ipil-ipil seed meal.....	—	5

Common table salt — 1 per cent of mash for the two lots.

When the New Hampshire chicks were studied, neither shrimp meal nor fish meal was available in the market from the thirty-eighth day of the

¹Experiment Station Contribution No. 1525. Prepared in the Department of Animal Husbandry under the direction of the junior author.

test, so that the shrimp meal in the rations was replaced with *Manamar*,² weight for weight.

The ipil-ipil seed meal was obtained by grinding mature ipil-ipil seeds that had been subjected to three-to-five-minute roasting in a frying pan on an open fire.

Feeding and care. Each lot was raised in separate, identical pens with concrete flooring, in which rice hulls were used as litter. Each pen had an adjoining ground run. During the first four weeks, the chicks were placed at night in the fireless brooding compartments of the pens. In succeeding weeks, they were allowed to roost on the low perches provided for them. The feed was given in the form of dry mash in feeding troughs accessible to the birds at all times of the day. Every morning, chopped green feed was given the birds from the time they were three weeks old until the end of the experiment. The chicks were subjected to the same care and management until they reached the weaning age of twelve weeks.

Records. The initial and weekly weights of the chicks until they were twelve weeks old, the amount of feed consumed, and the mortality were recorded.

RESULTS AND DISCUSSION

Rate of growth. It was noted that there was not much difference between lots I and II in initial weight of the Los Baños Cantonese chicks. The average initial weights were more than doubled the second week. At that age the chicks in lot I were, on the basis of standard error of difference, significantly heavier than those in lot II. This significant difference in weight persisted up to the end of the experiment when the Los Baños Cantonese chicks in lot I had an average weight of 782.7 ± 18.50 grams and those in lot II, only 661.1 ± 25.55 grams. The significantly heavier weekly weights of the Los Baños Cantonese chicks in lot I from the second to the twelfth week tend to show the superiority of the control ration over that containing ipil-ipil seed meal.

As in the Los Baños Cantonese chicks, there was not much difference in the initial weights of the two New Hampshire lots, and the chicks doubled their initial weights at the end of the second week. Throughout the twelve-week period, lot I was consistently heavier than lot II, although the weekly differences in weight were not big enough to be significant, except in the fourth and fifth weeks, when lot I was significantly heavier than lot II. At the weaning age of twelve weeks the average weights of the New Hampshire chicks were 554.0 ± 38.99 grams in lot I and 463.1 ± 44.80 grams in lot II. As a general rule, the New Hampshire fowl is heavier than the Los Baños Cantonese, but in this study the weanling New Hampshires

²*Manamar*, an imported feed, is a proprietary mixture consisting chiefly of kelp and fish meal which has a protein content of 40.9 per cent.

were lighter than the Los Baños Cantonese weanlings. This might have been due to the effect of the substitution of the shrimp meal in both rations with *Manamar* from the time the New Hampshires were 38 days old to the end of the experiment. The apparent inferiority of the ration in which 25 per cent of the shrimp meal was replaced by ipil-ipil seed meal was shown by the higher weights of the New Hampshire chicks in lot I during the first five weeks, especially during the fourth and fifth weeks, when the differences were significant. From the sixth to the twelfth week, the adverse effect of the addition of ipil-ipil seed meal was not appreciably significant when *Manamar* was used to replace all the shrimp meal in the two rations.

Borchers³ suggested that since ipil-ipil is a legume, heat treatment of the meal used in the study of Pizarro (1947) might have improved its nutritive value. He had been making a study of legume seeds and had been trying to connect the trypsin inhibitor found in some of them with the improvement found after heating as far as nutritive value is concerned. When Borchers examined the seeds of ipil-ipil sent to him for the trypsin inhibitor, he obtained a positive test.⁴ According to him, their present data show that the nutritive value of the seeds may or may not be improved by heating. That heating did not improve the nutritive value of ipil-ipil seed meal was verified in the present study in which the seeds were subjected to a three-to-five-minute roasting in a frying pan on an open fire before being ground into a meal. In this respect, ipil-ipil seed meal differs from soybeans. Heuser (1946) cited the results of studies in various experiment stations in the United States which showed the favorable effect of heat on the nutritive value of soybean meal and soybean oil meal.

Feed consumption. The amount of feed consumed by the birds in each lot, computed on the basis of 100 chicks, shows that the birds in lot II in both breeds consumed less feed than those in lot I. The Los Baños Cantonese chicks in lot II consumed 9.4 kgm. less than those in lot I; the New Hampshire chicks in lot II consumed 16.6 kgm. of feed less than those in lot I. Pizarro (1947) found that ipil-ipil seed meal was not relished by the birds when it formed 20 per cent of the ration; the present study shows that even when it formed only 5 per cent of the ration, it was still unpalatable.

When the amount of feed required to produce one kilogram weanling weight was considered, it was observed that the Los Baños Cantonese chicks in lot II needed 5.42 kgm. and those in lot I, only 4.70 kgm.

³Communication dated November 26, 1947, received by Professor F. M. Fronda from Raymond Borchers of the Department of Agricultural Chemistry, University of Nebraska, Lincoln, Nebraska, U. S. A.

⁴Communication dated February 10, 1948, received by the junior author from Raymond Borchers (*loc. cit.*).

The New Hampshires in lot II needed 6.10 kgm. and those in lot I, 5.40 kgm. On the basis of these figures and on the assumption that the lot that required the least amount of feed to produce one kilogram weanling weight was 100 per cent efficient, the relative efficiency of the ration containing ipil-ipil seed meal was 86.63 per cent in the Los Baños Cantonese lot and 88.43 per cent in the New Hampshire lot.

Mortality. Among the Los Baños Cantonese, the mortality during the 12-week period in lot I was 20.34 per cent, and in lot II, 47.97 per cent; among the New Hampshires, the mortality in lot I was 65.12 per cent, and in lot II, 76.74 per cent. It will be noted that the birds in lot II of both breeds had higher percentages of mortality than those in lot I. The very high mortality rate among the New Hampshire chicks was due mostly to chicken pox and to roup, which broke out during the fourth week of the experimental period.

The higher mortality rate of the chicks in lot II of both breeds may be attributed to their lower vitality as a result of the feed given them. The lesser vitality of these chicks may be caused by the toxic principle reported by Beaumont (1945) to be present in the ipil-ipil seeds. According to him, this toxic principle has been identified as mimosine ($C_8H_{10}N_2O_4$), which he claimed to be an alpha-amino acid possessing phenolic properties.

SUMMARY AND CONCLUSIONS

1. The results of this study show that the chicks that received a ration containing 5 per cent ipil-ipil seed meal did not grow so fast and were not so uniform in size as those that did not receive ipil-ipil seed meal in their ration.
2. The ration with the ipil-ipil seed meal was not so well relished by the chicks as the check ration.
3. If the control ration was considered 100 per cent efficient in producing a kilogram of weanling weight, the ration containing ipil-ipil seed meal was only 86.63 per cent efficient in the Los Baños Cantonese chicks and only 88.43 per cent in the New Hampshire chicks.
4. The percentage of mortality was higher in the lot that received the ration with ipil-ipil seed meal than in the control lot.

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AN EXTRA-EARLY YELLOW DWARF SOYBEAN¹

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The extra-early Yellow Dwarf soybean, which is likely to have popular use because of its early maturing habit, was recently improved in the Philippines. To improve it further and to determine its good as well as undesirable qualities, its morphological characters were studied in an experiment conducted in the experimental garden lots of the Department of Agricultural Botany from December, 1946, to January, 1948.

EXPERIMENT, RESULTS, AND DISCUSSION

The seeds of the extra-early Yellow Dwarf soybean developed in this College to the fifth generation, were used for this study. The original parent of this variety was an unnamed soybean distributed by the Emergency Control Administration during the early part of the liberation of the Philippines.

The three types of the bicolored strains of the Ami soybean studied by Abella² served as control. These three types were mixed thoroughly in the proportion of 1:1:1 by volume in order to get a more or less even distribution of the plants when grown in the field.

The seed coat of the extra-early Yellow Dwarf soybean is yellow and its hilum is dark brown. The seed coats of the bicolored Ami soybeans, however, are of two types, namely, (a) those with yellow seed coats and dark-brown hila, and (b) those with green seed coats and dark-brown hila.

For the dry- and wet-season cultures, the field was plowed three times with a locally made plow. Three days after the first plowing, it was harrowed with a locally made bamboo harrow. The same operation was repeated after the second plowing. Furrows were set one meter apart immediately after the third plowing and just before planting.

The dry-season culture was planted on January 4, 1947, and the wet-season crop on July 12, 1947.

The furrows were labeled with wooden tags attached to markers. Every fifth furrow was planted to Ami, the control, and all the other furrows

¹ Experiment Station Contribution No. 1526. Based on the thesis presented by the junior author for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture, March, 1948. Prepared in the Department of Agricultural Botany under the direction of the senior author.

²ABELLA, P. A. Analytical study of phenotypes and genotypes of (Biloxi × Ami) F₇ soybean hybrid segregates. (Thesis presented for graduation with the degree of Bachelor of Science in Agriculture, 1947. Unpublished.)

were planted to the extra-early Yellow Dwarf, all the plants being set at a distance of 50 centimeters in the furrow. This is the strain-to-the-row culture. This planting pattern was employed to avoid as much as possible differences due to soil heterogeneity in the test field.

Germination. There was no marked difference in the percentages of germination of the seeds of both the variety studied and the control. The percentages of germination for both strains in the dry- and wet-season cultures ranged from 93 to 100. The writers' observations are in accord with those of Abella³ who obtained percentages of germination of the Ami soybeans ranging from 95 to 100.

Blooming and fruiting periods. The extra-early Yellow Dwarfs bloomed very much earlier than the control. The majority of the plants in the dry-season culture bloomed on January 25, 1947, 21 days after planting. The control, Ami, did not flower until February 17, 1947, 42 days from the time of planting.

Most of the extra-early Yellow Dwarf plants in the wet-season culture flowered 22 days after planting; the control plants bloomed after 54 days. The extra-early Yellow Dwarf soybean, as well as the Ami, had the same range of days from flowering to fruiting. Pods were formed 5 to 8 days from blooming time in the dry- and wet-season cultures.

Maturity. Like the Ami variety, or control, the extra-early Yellow Dwarf variety showed uniformity as regards maturity of pods. The Yellow Dwarf was harvested 55 days after planting in the dry-season culture and 62 days after planting in the wet-season culture. The Ami crop was harvested after 97 days in the dry-season culture and 103 days in the wet-season culture. This earliness of maturity of the extra-early Yellow Dwarf strain is one of its most outstanding characteristics.

Plant characters

Height of plants. The extra-early Yellow Dwarf soybean is a small plant compared with the Ami. The results of the study on plant height of the dry- and wet-season cultures indicate that the Yellow Dwarfs studied were significantly shorter than the Amis. The figures in the table likewise show a highly significant difference in the mean heights of the two varieties. The difference may be considered varietal and inherent.

Because of its dwarfness, the extra-early Yellow Dwarf soybean should be grown preferably during the dry season, for in the wet season some pods situated all over in the stem generally touch the ground and rot.

Stem color. Soybean plants have purple or green stems, the purple color being most abundant just below the cotyledons.⁴ The extra-early

³*Ibid.*

⁴*Ibid.*

Yellow Dwarf soybean has green stems. The Ami variety on the other hand has purple stems.

Shape and distribution of pubescence. Microscopic study showed that both the extra-early Yellow Dwarf and the Ami had the blunt type of pubescence.

Nearly all soybean varieties have pubescences: the stems, leaves, and pods are covered with fine tawny, gray, or glabrous hairs. In this study, tawny pubescence covered the leaves, stems, and pods of both varieties. No plant of either variety was observed to have gray or glabrous hairs.

Flower color. The extra-early Yellow Dwarf soybean bears white flowers on a green stem; the Ami soybean has purple flowers on a purple stem. This association of flower and stem color corroborates the statement of Woodworth,⁵ who explains that this correlation may be due to the action of the same gene that governs the color of the stem and of the flower of the soybean.

Pod-bearing habit. The extra-early Yellow Dwarf has an indeterminate pod-bearing habit. The control variety also produced pods in the same way; that is, the pods were evenly distributed over all branches and stems, the number of pods borne at the top of the main stem being less than that borne at the middle of this stem. The indeterminate pod-bearing habit of the extra-early Yellow Dwarf is also a merit inasmuch as more pods are produced per plant.

Seed characters

Both the extra-early Yellow Dwarf and Ami soybeans bore one-, two-, and three-seeded pods. Neither variety produced four-seeded pods. The Yellow Dwarf had a mean of 2.35 one-seeded pods per plant in the dry-season culture. This is significantly lower than the mean of the control, 8.3 one-seeded pods per plant. A significant difference was also found in the wet-season culture. The extra-early Yellow Dwarf soybeans had also a significantly lower yield of two-seeded pods per plant than the control. The mean number of three-seeded pods of the extra-early Yellow Dwarf, however, was almost the same as that of the Ami; that is, the differences are insignificant. This insignificant difference is explained by Abella⁶ as due to the Amis's producing a relatively smaller number of three-seeded pods than two-seeded pods per plant.

The extra-early Yellow Dwarf variety produces more two-seeded pods than three-seeded pods per plant. The number of one-seeded pods is less than that of two- or three-seeded pods per plant.

⁵WOODWORTH, C. M. 1932. Genetics and breeding in the improvement of soybean. Illinois Agric. Exper. Sta. Bull. 384: 297-404. Fig. 1-34.

⁶*Ibid.*

The pods of the extra-early Yellow Dwarf are dark brown and those of the Ami are light brown.

The method of Ting⁷ in determining the relative sizes of the seeds of the extra-early Yellow Dwarf and Ami soybeans was used. The average weight of 100 seeds, based on ten samplings, of the extra-early Yellow Dwarf and Ami soybeans were taken. The seeds of the Yellow Dwarf were found to be significantly heavier than those of the Ami.

The seeds of extra-early Yellow Dwarf and Ami soybeans are globose, but the former are more nearly round than the latter.

The hardness of the seed coat was determined by the rapidity of water absorption by the seeds. The Yellow Dwarf seeds, as well as those of Ami, were found to absorb water completely in one to one and a half hours. This finding is in accord with Ting's observation in 1946, that most cultivated soybeans are soft-seeded, imbibing water completely in as short as one hour, the wild varieties taking as long as twenty-four hours.

The character of defective or cracked seed coat is undesirable because cracked bean seeds are not protected from pests and diseases and inclement weather. The extra-early Yellow Dwarf soybeans produced very few defective seeds. The same is true of the control, an observation which confirms that made by Abella.⁸

The extra-early Yellow Dwarf produced a significantly lower yield of pods per plant than the Ami. This low production is due to the fact that the extra-early Yellow Dwarf soybean is a comparatively smaller plant than the Ami.

The extra-early Yellow Dwarf yielded significantly fewer seeds per plant than the Ami because it produced fewer pods per plant and seeds per pod.

Since it takes twice as long for one culture of the Ami soybean to mature, two cultures of extra-early Yellow Dwarf to one of Ami may be grown in the same length of time. The yields of these two cultures, however, may not equal or surpass the yield of one culture of the Ami.

SUMMARY

1. The extra-early Yellow Dwarf soybean plants experimented on were relatively uniform in germination, in blooming and fruiting periods, and in maturity of pods. They bloomed 21 to 22 days after planting and were harvested when 55 days old in the dry-season culture and 62 days in the wet-season culture.

⁷TING, C. L. 1946. Genetic studies on the wild and cultivated soybeans. Jour. Amer. Soc. Agron. 38 (5): 381-393.

⁸*Ibid.*

2. The mean height of plants ranged from 27.6 cm. to 29.05 cm. in the Yellow Dwarf, and from 67.55 cm. to 69.00 cm. in the Ami variety, or the control.

3. The stem of the Yellow Dwarf is green and has tawny hairs with blunt tips. Its flowers are white and are borne indeterminately on the plant. The pods are dark brown and are one- to three-seeded. The two-seeded pods predominate in each plant.

4. The seed coats of the extra-early Yellow Dwarf soybeans are yellow, with dark hila. The Ami is bicolored, the seed coats being either green or yellow, but the hila are dark brown.

5. The extra-early Yellow Dwarf seeds are globose like those of Ami, but they are heavier and more nearly round.

6. The seeds of both the extra-early Yellow Dwarf and the Ami possess soft coats, both varieties absorbing water completely within one to one and a half hours after soaking.

7. The yield of the extra-early Yellow Dwarf ranged from 9.8 to 13.3 pods per plant, which is very low compared with that of Ami with means ranging from 48.8 to 59.35 pods per plant. The seeds produced averaged from 19.55 to 27.65 per plant for the Yellow Dwarf, and 84.04 to 93.8 for the Ami.

TABLE 1

Summary of statistical data on plant and seed characters of extra-early Yellow Dwarf and Ami soybean

CHARACTERS	YELLOW DWARF	AMI	MEAN DIFFERENCE
Plant height (cm.)			
Dry season	27.60	67.65	Significant
Wet season	29.05	69.00	
No. of one-seeded pods			
Dry season	2.35	8.30	Significant
Wet season	2.90	13.95	
No. of two-seeded pods			
Dry season	5.40	13.90	Significant
Wet season	4.30	29.50	
No. of three-seeded pods			
Dry season	3.70	5.90	Insignificant
Wet season	4.55	5.90	
Weight of 100 seeds (grams)			
Dry season	15.99	13.11	Significant
Wet season	16.12	12.66	
No. of pods per plant			
Dry season	13.30	59.35	Significant
Wet season	9.80	48.80	
No. of seeds per plant			
Dry season	27.65	93.80	Significant
Wet season	19.55	84.05	

SUN PORCH FOR BROODING CHICKS¹

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In an earlier paper, Castillo² reported that the use of the sun porch for brooding chicks did not produce any advantage over the common method of brooding. In the latter method, chickens are confined in houses with either dirt or concrete floors and are provided with good litter and bare or grassy runs. The results of another study along this line conducted in the Department of Animal Husbandry from December 17, 1946, to July 31, 1947, are presented in this paper.

MATERIALS AND METHODS

In the present study, the comparison was made between the ground-run and the sun-porch methods of brooding 162 Single Comb White Leghorn and 200 New Hampshire chicks. The chicks of each breed were wing-banded and randomized into two lots. There were 81 chicks in each lot in the case of the S. C. White Leghorns and 100 chicks each in the case of the New Hampshires. The initial weights of the chicks were taken and the chicks were weighed biweekly thereafter till the weaning age of twelve weeks. The College chick ration, consisting of 55 per cent fine rice bran, 20 per cent ground yellow corn, 20 per cent shrimp meal, and 5 per cent copra meal, all parts by weight, was fed dry to the chicks. Finely cracked yellow corn was hand-fed to both lots beginning the fifth week. Every morning finely cut green grass was given to the chicks *ad libitum*. Ground shell and grit in open bamboo troughs were available to them throughout the experiment.

The sun porches were made of bamboo slats spaced about one and one-half centimeters apart. The chicks were provided with identical fireless brooders and concrete-floor scratching pens with rice hulls as litter. The sun porches and ground runs had the same area. During the day the chicks were allowed the scratching pens and ground runs or sun porches as the case may be. At dusk the chicks were confined in the fireless brooders for the night, and in the morning they were let out into the scratching pens. On the third week, feeding and watering troughs were also placed outside the house to encourage the chicks to go out. When the chicks were about four weeks old, they were allowed to roost on the low perches provided for them.

¹Experiment Station Contribution No. 1527.

²CASTILLO, LEOPOLDO S. 1948. The influence of two chick rations and two methods of brooding on the rate of growth and mortality of chicks. *Philippine Agriculturist* 32: 123-136.

The weanling pullets in all the lots were classified and the cockerels were separated at the end of the brooding period. The classification was based on the following points: general appearance, vigor, size, and pigmentation. All the pullets retained were given the College rearing ration.

RESULTS AND DISCUSSION

Rate of growth. The data obtained in this study showed that, at four days and four, ten, and twelve weeks old, the standard error of the difference of the weights between the ground-run-reared and sun-porch-reared S. C. White Leghorn chicks was insignificant, although the weights of the former were slightly heavier than those of the latter. At other weighing periods, however, the chicks which used the ground runs were significantly heavier than those which had access to the sun porch. According to the "t" test of the weight-averages, the difference in weight of the two lots in the whole experiment was significant in favor of the ground run.

The weights of the S. C. White Leghorn chicks at the weaning age of twelve weeks were 652 ± 22.0 grams for the ground-run lot and 600.6 ± 24.8 grams for those brooded in the sun porch. On the assumption that the heaviest average weight of weanlings may be assigned 100 per cent efficiency, the relative efficiency of the chicks of the ground-run lot was 100 per cent, while that of the sun-porch lot was 92 per cent.

In the case of the New Hampshire chicks, at the start of the experiment those that were allowed on the ground run had an average weight of 48.1 ± 0.5 grams, while those in the sun porch had an average weight of 51.5 ± 0.7 grams. The difference of 3.4 ± 0.9 grams is significant. Likewise, the chicks of this lot were significantly heavier than those on the ground run at the end of the fourth week. From the sixth to the twelfth week, however, the ground-run brooded chicks were significantly heavier than those brooded in the sun porch. At weaning time, the chicks of this lot weighed 670.9 ± 20.3 grams, while those in the sun porch weighed only 602.4 ± 25.7 grams. The difference of 68.5 ± 32.7 grams is significant. The relative efficiency of the former might be taken as 100 per cent while that of the latter, only 89.8 per cent.

These results differ from those reported by Hinds³, and Mehrhoff, Ward, and Moore⁴ who observed very little difference in the weights of chicks brooded in "the sun parlor" and those raised on the ground run.

³HINDS, H. B. 1937. Confinement rearing. Part II. Arizona Agric. Exper. Sta. Bull. 159: 177-182.

⁴MEHRHOFF, N. R., W. F. WARD, AND O. K. MOORE. 1943. Effect of method of rearing S. C. White Leghorn chicks upon rate of growth, feed efficiency, and mortality. Florida Agric. Exper. Sta. Bull. 394: 1-12.

Mortality. Observations on the mortality of the chicks in the different lots in this study showed that in both breeds the mortality was high from the fifth to the eighth week. The S. C. White Leghorn chicks which had access to the ground run had a total mortality of 30.7 per cent at the end of the eighth week, while those in the sun porch, 35.8 per cent. The difference, however, was not statistically significant. On the other hand, in the case of the New Hampshire chicks, only 35.0 per cent died in the ground-run lot, while 54.8 per cent died in the sun-porch lot. Computed on the basis of 100 per cent efficiency for the lots with the least mortality, both the ground-run lots of both breeds were 100.0 per cent efficient. The sun-porch lot of the S. C. White Leghorn chicks was 85.7 per cent efficient, while that of the New Hampshires was only 64.8 per cent efficient.

Amount of feed required to produce a unit of gain. It was observed that the chicks of both breeds which used the sun porches consumed more feed to produce a unit of gain than those which used the ground runs. At the end of twelve weeks, the total amount of feed consumed by the S. C. White Leghorn chicks on the ground run was 305.9 kgm. Each lot, however, required 503.9 and 520.4 kgm. of feed, respectively, to produce 100 kgm. of gain. The New Hampshire chicks raised on the ground run consumed 307.7 kgm., while those in the sun porch consumed 298.0 kgm. Each lot required 493.9 and 541.8 kgm. of feed, respectively, to produce 100 kgm. of gain. These results corroborated the findings of Mehrhoff, Ward, and Moore in 1943 that sun-parlor chicks require more feed to produce a unit of gain.

If the lot that consumed the least amount of feed to produce a unit of gain is considered as 100 per cent, both the ground-run lots of both breeds used in this study were 100 per cent efficient. The sun-porch brooded S. C. White Leghorns were 96.8 per cent, and the New Hampshires, 91.2 per cent efficient.

Quality of the weanlings. At the age of twelve weeks when the weanlings were classified, 31 S. C. White Leghorn pullets, or 52.5 per cent, on the ground run and 28 pullets, or 47.5 per cent, in the sun porch were selected as Class A. Of the 100 selected New Hampshire pullets, 62.0 per cent were from the ground-run lot and only 38 pullets, or 38 per cent, were from the sun-porch lot. These figures show that the ground run produced pullets of better quality than the sun porch.

Sexual maturity. All the S. C. White Leghorn pullets on the ground run laid at the average age of 163.1 ± 3.5 days. Of the pullets in the sun porch, two had not laid any egg by the thirty-second week, although 25 pullets, or 92.6 per cent, of the 27 pullets laid their first eggs when they were 166.1 ± 2.3 days old. On the other hand, of the New Hampshire pullets raised on the ground run, 30 pullets, or 51.7 per cent, of the 58 pullets

laid when 157.9 ± 0.6 days old, while 20 pullets, or 60.6 per cent, of the 33 pullets in the sun porch laid when 159.7 ± 0.6 days old. It is interesting to note that the S. C. White Leghorn pullets laid slightly later than the New Hampshires.

SUMMARY

1. The ground-run-reared chicks of both breeds were heavier than those reared in the sun porch.

2. There was no significant difference in mortality between the ground-run and sun-porch-brooded chicks among the S. C. White Leghorns. In the case of New Hampshires, however, the ground-run-brooded chicks had a significantly lower mortality than those brooded in the sun porch.

3. To produce a unit of gain, the sun-porch-brooded chicks required more feed than those on the ground-run.

4. The quality of the weanlings produced on the ground-run lots of both breeds was better than that of the sun porch lots.

A REVIEW: CHEMICALS, HUMUS, AND THE SOIL^{1, 2}

Donald P. Hopkins in a 358-page book entitled, "*Chemicals, Humus, and the Soil*" intended the concise contents for the layman "who does not know which journals contain authoritative accounts of research work nor would he find these accounts simple reading if he tackled them". The author discussed and presented the subject matters in a simple, clear, and concise language. He bore in mind the idea from Hippocrates, "If you miss being understood by laymen, you will miss reality."

The book is divided into two parts; the first consists of eleven chapters which deal with chemical fertilizers. The modern concepts of chemical fertilizers, organic manures, and the general principles of maintaining the optimum condition of soils for growing crops are reviewed extensively. The ABC's of chemical fertilizers are discussed comprehensively in chapters I to V, that of organic manures in chapter VI, and that of the principles of maintaining soil fertility in the last five chapters.

This part of the book is a very valuable guide for students and amateur practitioners in agriculture, particularly those who have missed the chance to learn and observe the true values of chemical and organic fertilizers and the minor elements in the production of crops.

In the second part of the book, the author presents the numerous anti-fertilizer contentions of the followers of the humus school of thought. Because of the too one-sided presentation of the knowledge on organic manures, the author reviews the opinions of workers who have studied the controversy between supporters of the chemical fertilizers and those of the organic fertilizers. This part of the book stimulates the reader to search data supporting the chemical fertilizer idea and also to refute the charges against adherents of the chemical fertilizers.

Although all the information in the book are based on experiments performed in other countries, they provide facts that may reinforce our present knowledge of chemical and organic fertilizers in relation to soil and crops. The scope of the book makes it useful not only to students and teachers but also to experiment station workers on soils and plants. Since the two schools of thought are authentically discussed in this book, the reader will not only be compelled to express his personal view but also be

¹General Contribution No. 792.

²DONALD P. HOPKINS. 1948. *Chemicals, humus, and the soil*. vii + 358 p., 1 frontispiece. Brooklyn, N. Y.: Chemical Publishing Co., Inc. \$8.50.

induced to carry out experiments to settle once and for all the chemical-organic fertilizer issue.

The bibliography at the end of the book is of value to students, teachers, and researchers dealing with chemical fertilizers, organic manures, soils, and crops.

N. L. GALVEZ
Of the Department of Soils

COLLEGE AND ALUMNI NOTES

At the instance of Dr. Charles Harvey Brown, chairman of the committee on the Orient and Southwest Pacific of the American Library Association, valuable publications were donated to the College. Those received from the Smithsonian Institution include 125 volumes of the American Shorthorn herd books, and those from the American Library Association are back numbers of *Science*, *The Scientific Monthly*, and *Food Industries*.

In the elections of the different student organizations of the College, the following were selected presidents and advisers for the second semester, 1948-1949: Senior — Paulino F. Cayco, president; Dr. V. C. Calma, adviser; Junior — Augusto Gonzalez, president; Professor A. B. Catambay, Adviser; Sophomore — Manuel Iñigo, president; Dr. F. M. Fronda, adviser; Speech and Dramatics Club — Thomas Flores, president; Miss Nelly Dunglao, adviser. Leonardo Paulino and Oscar Mabanag were elected Senior and Junior representatives to the U. P. Student Council, respectively.

The U. P. Rural High School student body elected Tomas Lapis president for the second semester. Mr. Quirino Tagorda is the adviser of the U.P.R.H.S. Student Body Organization.

The other organizations in the College and their presidents and advisers are as follows: Freshmen — José O. Juliano, president, and Dr. S. M. Cendaña, adviser; Philippine Country Life Association — Andres D. Goseco, Jr., president, and Dr. F. M. Sacay, adviser; Soil Tillers Photographic Club — Janairi S. Kibtiani, president, and Mr. A. P. Varona, adviser; Mimes-Mummers-Scribblers Fraternity — Leandro G. Sinco, grand consul, and Dr. L. G. Gonzalez, adviser; Ranchers' Club — Almario de los Santos, governor, and Dr. F. M. Fronda, adviser; and Associated Women Students—Guadalupe A. Rola, president, and Mrs. J. P. Gapud, adviser.

Mr. Lauro A. Ynalvez, '29, instructor in agricultural chemistry, has been appointed chemist of the Institute of Nutrition. He is at present undertaking analytical work in the Department of Chemistry of the College under the supervision of Dr. F. O. Santos, a member of the Institute.

Miss Fabiana E. Alviar, '48, is working with Mr. Ynalvez as technical assistant.

The members of the Burma Trade Mission visited the campus on December 21, 1948. They were Messrs. U. Kyin, O. B. E., Minister of Finance of the Government of Burma; U. Nyun, Minister of Commerce; and U. Thet Su, Director of Agriculture. The visitors were accompanied by Mr. Artemio E. Gesmundo, '30, of the NARIC.

Mr. Ian Khambanonda, '39, has recently finished his Ph. D. at Iowa State College. He visited Mr. Crispin Las Marias, '36, at the Texas Agricultural and Mechanical College during the 1948 Christmas vacation.

A letter received by Professor R. B. Espino from Dr. E. B. Copeland, founder and first dean of this College, contained the sad news that Mrs. Carrie Stein Ledyard died on March 12, 1948, in the United States. Mrs. Ledyard taught English and German to the early students of the College and was a member of that small group of Americans who successfully did the pioneering work in the establishment of this College.

The zoology and botany classes of the College of Liberal Arts, U.P., made an educational trip to the College on January 23, 1949. The students were accompanied by Dr. and Mrs. Gregorio T. Velasquez, Miss Adelaida Tolentino, and Messrs. Joventino D. Soriano, '44, and Fernando Gutierrez.

Two alumni recently returned from international conferences abroad. Congressman Domingo B. Paguirigan, '16, was the chairman of the Philippine delegation to the FAO conference in Washington, D.C. Mr. Agustin Mañgila, '40, was secretary of the Philippine delegation to the ECAFE conference which was held in Australia.

Mr. Ramon Ordoveza, '28, manager of Carmelo and Bauermann, Inc., printed free of charge the campaign letter sent to alumni by the Copeland Travel Fund Committee. The work was worth about two hundred pesos.

Dr. Deogracias V. Villadolid, '19, Director of the Bureau of Fisheries, returned recently from abroad. He was a member of the Philippine delegation to the FAO conference which was held in Washington, D. C.

The majority of the newly elected officers of the Soil Science Society of the Philippines are alumni of the College. They are as follows: Messrs. Dominador Z. Rosell, '28, president; Juan B. Cabanos, '19, vice-president; Fernando de los Reyes, '35, secretary; Bienvenido Evangelista, treasurer; Ignacio R. Ang, '32, auditor; Alfredo Barrera, '35, chairman, division of soil genesis, morphology, and cartography; Ramon Samaniego, '40, chairman, division of soil physics and mechanics; Ricardo T. Marfori, '30, chairman, division of soil chemistry and mineralogy; Rufino Isidro, '20, chairman, division of soil fertility; Martin S. Celino, '29, chairman, division of soil microbiology; Jesús P. Mamisao, '30, chairman, division of soil technology; and Juan A. Mariano, chairman, division of soil geography.

THE EXPERIMENT STATION

LIST OF AVAILABLE CIRCULARS AS OF FEBRUARY, 1949

- No. 2.—Bud Rot of Coconut..... *By G. O. Ocfemia*
- No. 8.—Horse Breeding in the Philippines..... *By V. Villegas*
- No. 10.—Practical Directions for Coffee Planting..... *By Pedro A. David*
(Revised by Charles Fuller Baker, Dean, College of Agriculture,
1917-1927.)
- No. 11.—The New College Copra Drier—Prepared in the Department of
Agricultural Chemistry with the cooperation of the Department of
Agronomy and Extension. (Revised)..... *By Moises M. Kalaw*
- No. 17.—College Trapnest..... *By F. M. Fronda and P. S. Paje*
- No. 18.—Surveying for Area with a Surveyor's Staff.. *By Alexander Gordon*
- No. 23.—Curing Pork and Making Sausage for
Home Use..... *By Mariano Mondoñedo*
- No. 24.—Construction and Operation of Silos in the
College of Agriculture..... *By J. P. Esguerra*
- No. 26.—Training Cattle and Carabaos for Work.... *By Valente Villegas*
- No. 28.—Cotton Culture..... *By Eulalio P. Baltazar*
- No. 29.—Collegiate Education in Agriculture..... *By Leopoldo B. Uichanco*
- No. 30.—What Should Filipino Ornamental Gardens
and Ornamental Plants Be?..... *By N. B. Mendiola*
- No. 32.—Hog Raising..... *By Mariano Mondoñedo*

The price of the circulars listed above is thirty centavos (₱0.30) each.

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COLLEGE, LAGUNA, PHILIPPINES.

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(Required by Act No. 2580)

The undersigned, business manager of THE PHILIPPINE AGRICULTURIST, published quarterly in English at the College of Agriculture, College, Laguna, after having been duly sworn in accordance with law, hereby submits the following statement of ownership, management, circulation, etc., which is required by Act 2580, as amended by Commonwealth Act 201:

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J. M. CAPINPIN
Business Manager

Subscribed and sworn to before me this 7th day of October, 1949, at Los Baños, Laguna, the affiant exhibiting his Residence Certificate No. A3223098, issued at Los Baños, Laguna, on January 4, 1949.

AURELIO C. ALMASAN
Municipal Mayor
Los Baños, Laguna